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ENVIRONMENTAL IMPACT ASSESSMENT
TREKKOPJE ROAD

Prepared for:
AREVA RESOURCES - NAMIBIA

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EXECUTIVE SUMMARY

In 2007 the AREVA group acquired AREVA Resources Southern Africa, previously known as UraMin Inc. AREVA Resources Southern Africa represents AREVA's uranium mining interests and activities in Africa, with the exception of Niger and Gabon. The company is set to become a leading producer of uranium and has plans in place to supply substantial quantities of mined uranium within a short to medium timeframe. The AREVA group presently operates in Namibia, the Central African Republic and South Africa through its respective subsidiaries; AREVA Resources Namibia, AREVA Resources Centrafrique and AREVA Lukisa.

AREVA Resources Namibia has appointed Turgis Consulting (Pty) Ltd. of South Africa, acting in collaboration with other independent consultants in South Africa and Namibia to undertake and Environmental Impact Assessment (EIA). Turgis Consulting is an established consultancy, widely experienced in providing expert services to mining operations globally and in Africa.

This report addresses the environmental and social impacts of the construction and operation of the proposed new tarmac access to Trekkopje mine, from Arandis. The access road EIA commenced formally in April 2009, although significant background work relating to the choice of route and the possible location of borrow pits, was undertaken as part of the existing mine Environmental and Socio-economic Impact Assessment (ESIA) process prior to this.

The principle justification of the project is to optimize travelling time, carbon emission through fuel consumption and safety of employees and the general public. In this regard, AREVA undertook a review of the access road alignment. Road accident rates are directly proportional to distance travelled (i.e. longer roads are likely to result in greater numbers of accidents, all other parameters being equal). Consequently, a more direct route to the main mining area that runs directly from Arandis has been selected as the proposed alignment of the new access road.

AREVA's proposed new mine access road from Arandis to the Trekkopje mine will make a substantial contribution to economic development in Namibia as a whole and specifically to the Erongo Region, where the operation will be located.

The alignment of the mine access route has important implications. These can be summarised as follows:

- Biodiversity: The project is located in the hyper-arid Central Namib, a desert area with high levels of endemism and fragile ecosystems. Construction of access routes is likely to negatively impact on rare species.
- Landscape dissection: The project lies within the //Gaingu Conservancy, a wilderness area set aside for community-based natural resource management. The low agricultural potential of the area restricts conventional agricultural activities and

consequently, the primary potential benefit to the community arises through conservation and ecotourism.

- Social impacts: Two of the proposed access routes pass in close proximity to the town of Arandis. The increased presence of truck drivers, mine employees and contractors may result in increased levels of social ills such as alcohol and substance abuse, as well as prostitution. Increased traffic may disrupt the social fabric of the town.
- Health and safety: One of the proposed access routes is longer than the other two. It also requires more kilometres travelled on a national road. The potential for accidents (motor vehicle and pedestrian) is thus higher. The other two routes both pass close to Arandis and could potentially increase pollution levels experienced by the town.
- Carbon emissions: One of the routes is more direct than the other two and will result in considerable reductions in carbon dioxide emissions from vehicles.
- Operational expenditure: One of the routes is more direct than the other two and will result in considerable reductions in fuel consumption.

The proposed new access route will be a bitumen surfaced two-lane road starting from Arandis rail siding and ending at the, to be constructed, Maxi pad at Trekkopje Mine. The road will closely follow the current temporary water supply pipeline that supplies the mine with water from Rössing reservoir. The new road will be a private road for mine vehicles only, with a security check point at Arandis – no public access will be allowed as AREVA will be operating large “road-train” transport vehicles.

The proposed road will have a bitumen surface and be 7.6 m wide (with a 1.5 m gravel shoulder on either side). Each driving lane will be 3.5 m wide with 300 mm allowed for painting of yellow lines. The road may at certain locations, where required, be raised to between 1 and 1.5 m above ground level in order to remain within the road profile. The road will be constructed to Namibian and international standards and will be designed to carry heavy vehicle traffic at speeds of up to 80 km/h.

Water requirements for the road construction will come from the existing temporary mine pipeline. This temporary pipeline extends from Rössing Reservoir in Arandis to Trekkopje Mine.

The Arandis road and rail siding terminal will be upgraded and developed to accommodate the transport and handling of all mine related materials and products. The intention is to transport material by rail to Arandis where it will be cross-loaded onto road trains and transported via the new road to Trekkopje Mine.

Construction for the proposed new access road requires the use of fill material that will principally be sourced from two avenues; borrow pits and suitable mine overburden material. An additional source of fill material is from cutting V-sections through ridges and filling the required areas with the material. This form of material source alters the natural relief and morphology of the landscape permanently and therefore has been discarded as an option for the Areva road. The formation of major cut and fill zones will be extremely difficult to rehabilitate and will be out of character with the terrain. Where the road crosses over drainage lines, washes and dry riverbeds concrete structures are placed to divert and channel the water. The borrow pit material is required to fill the voids in order to remain within the profile of the road.

The proposed road from Arandis to Trekkopje Mine would require an estimated total of 608 000 m^3 of various forms of fill material.

On completion of the regulatory process and a positive record of decision is received to continue with the development of the road the detailed design phase will commence. On completion of the detailed design phase the tender and physical construction phases will commence. It is expected that the entire process will take approximately 14 – 18 months to complete.

International best practise requires that alternatives to a proposed activity be considered. Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the no-go alternative. (The no-go alternative is the option of not undertaking the proposed activity or any of its alternatives.

Three alternatives were assessed, the “no-go” option being the upgrade of the current access road, the temporary pipeline route from Arandis to the mine, and an access road from Arandis to a quarry located west of the mine. A detailed multiple accounts analysis was used during thr alternatives assessment taking into consideration environmental, social, technical and project economic aspects.

Taking into account the numerous factors and associated impacts related to the project the preferred alternative is to construct the access road following the temporary pipeline route. Chapter 8 details the predicted environmental impacts related to the construction of the road.

Specialist studies undertaken as part of the EIA included, Biodiversity, Archaeology, Noise and Social impacts.

The most significant impacts on the biophysical and socio-economic environments include the following:

- dust dispersion as a result of construction activities

- residual impacts potentially arising from borrow pits and un-rehabilitated surfaces on closure
- direct loss of habitat and animal species as a result of the road infrastructure and additional road kill due to vehicle movement
- disruption of established surface water channels
- continued fragmentation of the desert habitat
- expansion of the local, regional and national economies through economic multipliers (procurement, services, salaries, taxes, royalties)
- increased employment through the creation of jobs
- potential disruption of the existing social order

It is inevitable that road developments intersect drainage basins. Where this intersection occurs, the alteration of local hydrology is inevitable. The most important water related impacts associated with the road will be surface destruction through construction activities and the channelling of the many dry riverbeds and washes. Through effective design and alignment of the road and with the placement of adequate drainage points, the impacts related to the water regime can be mitigated. Adequate drainage points will also allow for the continuous movement of fauna (and flora through streamflow activity) to continue relatively undisturbed.

Desert ecosystems are characterized by extreme temperature fluctuations, low annual rainfall, and high evaporation. As a result, species diversity tends to be low (and indigenous). Due to the climate in the area, recovery or re-colonization of damaged areas tends to be slow, therefore due to the ecosystem sensitivity and habitat specific genetic adaptation the Trekkopje area has been rated as high for conservation importance. Through road construction activities the impacts related to the loss of fauna and flora and fragmentation of the habitat will occur. For these impacts not to remain permanent the recommendation from a biophysical point of view is to remove the road on mine closure and rehabilitate the disturbance corridor to allow the habitat to return to its pre-mining state.

At present, dust in the area only occurs under strong wind conditions. Future air impacts will be primarily due to road construction. There will be temporary creation of dus, during the construction period and carbon emissions and fume pollution from traffic activities during operation. With sufficient application of water to working surfaces, dust related impacts should not be significant beyond that of nuisance value. The adequate supply of water is a potential constraint to effective dust management.

The emission of pollutants by vehicles has worldwide impacts and contributes greatly to the total atmospheric pollution generated by people. As the new access road is considerably shorter, it will have fewer impacts related to vehicle emissions, than the current road.

The road has been designed to be further west of the temporary pipeline. This is to accommodate future expansion in Arandis and to minimise the impact of operational noise on communities close by.

A field survey identified eleven archaeological sites of which nine are associated with harvester ant seed caches. These sites are not archaeological occupation sites but indicators of such sites that possibly occur within a 4 km radius. Sites located in the path of the access road will be destroyed, and there may be further indirect impacts resulting from a lateral disturbance on either side of the route itself. However, according to the scales employed in Namibian archaeological assessments, the significance of the sites is very low.

Bitumen surfaced roads require large amounts of fill material in various layers and thicknesses. These layers are required to provide a stable platform to carry the intended loads and for the integrity of the road to remain intact under such loads and use conditions. Where the road crosses over drainage lines, washes and dry riverbeds concrete structures are placed to divert and channel the water. Borrow pit material is required to fill the voids in order to remain within the profile of the road. The proposed road from Arandis to Trekkopje Mine would require an estimated total of 608,00 m^3 of various forms of fill material. Road construction requires the construction of borrow pits for fill material. Due to the availability of suitable material in these areas, washes and drainage channels will be compromised. However, the use of suitable mine overburden material can decrease the impact on the environment by minimising the number of borrow pits.

Spillage from storage areas, re-fuelling tanks, tar mixing, storage, other road construction infrastructure and during transportation can lead to contamination of surface soils and water. Pollutants can degrade habitat, disrupt biological processes, reduce biodiversity and reduce utility of landscapes. The reagents proposed for the Trekkopje project are bulk chemicals. Such chemicals present low hazard levels and are generally rated in the lower quartile of chemicals assessed for hazardous characteristics using the Indiana Relative Chemical Hazard Score (IRCH). Notwithstanding this, there are a number of suspected health hazards associated with these chemicals.

Transport and use of hazardous chemicals in most instances carries an inherent risk. Through effective management, the identification of the risks and an efficient emergency response plan, the risks associated with the Trekkopje operation can be managed to pose a minimal threat to the environment and humans in the area.

International best practise requires that closure related issues be taken into project planning throughout the life of the mine. Closure related aspects for this project are related to the permanency of the road infrastructure. The recommendation is to remove the road corridor and rehabilitate the corridor to restore it to its current state.

The construction phase of the project is characterised by a number of negative social impacts, mainly due to the nature of the activities that take place during this phase. However, these impacts are only temporary in nature, lasting over the construction period. There are also a number of positive impacts, which can be enhanced if managed effectively.

A huge benefit that the construction of the proposed access road can bring to the local community is that of employment, albeit on a temporary basis. The use of local labour, i.e. people who already reside in Arandis, will also circumvent further overcrowding in Arandis and additionally, negate other potential social impacts associated with the influx of construction workers, by preventing conflict over scarce resources, or because of dissimilarities in social practices.

Overall, based on the conclusions and findings of this report, the construction and operation of the proposed access road does not pose any social impacts that are deemed irreversible, fatally flawed, or severely detrimental to the social environment.

From a biophysical perspective the current access road will experience additional impacts through the provision of power, water and infrastructural services to accommodate the project. In addition, the post closure use of such infrastructure will not offset the environmental impacts associated with them as there are at this stage no planned uses for them.

The possible economic benefit that Arandis will accrue through post Trekkopje use of the infrastructure associated with the road & rail terminal holds tremendous potential. The presence of the terminal at Arandis will possibly act as a catalyst for further development thereby enhancing economic opportunity for the community.

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1 INTRODUCTION

1.1 Company Details

In 2007 the AREVA group acquired AREVA Resources Southern Africa, previously known as UraMin Inc. AREVA Resources Southern Africa represents AREVA's uranium mining interests and activities in Africa, with the exception of Niger and Gabon. The company is set to become a leading producer of uranium and has plans in place to supply substantial quantities of mined uranium within a short to medium timeframe. The AREVA group presently operates in Namibia, the Central African Republic and South Africa through its respective subsidiaries; AREVA Resources Namibia, AREVA Resources Centrafrique and AREVA Lukisa.

AREVA Resources Southern Africa currently employs approximately 250 people in its various operations. The company subscribes to the AREVA group's principles on sustainable development to minimise damage to the environment while ensuring that communities surrounding an operation benefit from AREVA's involvement.

The AREVA group's strategy is to explore its existing projects, develop those for which favourable feasibility studies are completed and acquire and progress further uranium properties at various stages of development.

1.2 Consultants

AREVA Resources Namibia has appointed Turgis Consulting (Pty) Ltd. of South Africa, acting in collaboration with other independent consultants in South Africa and Namibia to undertake and Environmental Impact Assessment (EIA). Turgis Consulting is an established consultancy, widely experienced in providing expert services to mining operations globally and in Africa. The company employs a team of experts whose experience and knowledge ensures a high degree of professionalism in all aspects relating to the design and operational support of mines. Turgis has experience in EIAs and audits of uranium projects in the Central Namib and undertook the EIA for the Trekkopje Mine. Specialist knowledge of Namibian conditions is vital to this project, and for this reason Namibian experts make up an important component of the team. TABLE 1.1 lists the project team members.

TABLE 1.1 – PROJECT CONSULTANTS	
Peter Roux	Project Manager & Public Participation Consultant
Daniel Limpitlaw	Principal Environmental Consultant
Nonka Byker	Principal Social Consultant
Dr Joh Henschel	Biodiversity (Fauna & Flora)
John Kinahan	Heritage
Francois Malherbe	Noise
Dave Montgomery	Road Design

1.3 Scope of This EIA

This report addresses the environmental and social impacts of the construction and operation of the proposed new tarmac access to Trekkopje mine, from Arandis. With the permission of the Ministry of Environment and Tourism (MET), the EIA is being phased, with this report being Phase 2. Phase 1 of the project was the undertaking of a scoping/screening assessment which included the assessment of alternatives and a first round public consultation process. These two phases form the complete project EIA.

The access road EIA commenced formally in April 2009, although significant background work relating to the choice of route and the possible location of borrow pits, was undertaken as part of the existing mine Environmental and Socio-economic Impact Assessment (ESIA) process prior to this.

Key stakeholders were identified through the work undertaken for the mine ESIA. Public announcements were made in May and June 2009 regarding the proposed new access road EIA. A key stakeholders group meeting was held prior to the public meetings by virtue of the stakeholder engagement process.

This EIA report, of the proposed new access road for the Trekkopje mine, to be undertaken by AREVA Namibia (Pty.) Ltd describes:

- The public participation process and consultation methodology;
- Stakeholder issues and concerns;
- An overview of the scoping/screening process;
- The socio-economic survey;
- The biodiversity survey;
- The heritage survey;
- The noise survey;
- The environmental impacts identified by an analysis of the public participation process and baseline studies; and
- The Environmental Management Plan (EMP) for the avoidance, mitigation and/or optimisation of the identified impacts

1.4 Structure of This EIA

The report is structured as follows:

- An executive summary, which provides an overview of significant findings and recommended actions.
- This chapter (Chapter 1) contains details of the project proponent and the EIA consulting team. It focuses on the contribution that the road and its associated infrastructure will make to the Trekkopje Uranium Project.
- Chapter 2 provides the background information to the project.
- Chapter 3 details the regulatory requirements within which the EIA was conducted, as well as other commitments which AREVA will need to comply with during operation of the road.
- Chapter 4 details the methodology used as part of the assessment.
- Chapter 5 provides a technical description of the project. These details provide an understanding of the nature of the project, its extent and timing.
- Chapter 6 presents an overview of the scoping/screening process.
- Chapter 7 undertakes a consideration of alternatives.
- Chapter 8 details the assessment of identified potential impacts for each of the components and explains how these were arrived at and ranked.
- Chapter 9 presents the social impact assessment.
- Chapter 10 presents the public consultation process.
- Chapter 11 provides concluding remarks and the list of references cited in this report.
- Chapter 12 lists the references cited in support of the EIA.

1.5 Project Objectives

An EIA study seeks to predict the impacts of a proposed project on the human and natural environment, and to determine the optimal management measures for these impacts. The study is by definition multi-disciplinary, and attempts to identify the methods, approaches and alternatives which represent the optimal combination of economic, social and environmental costs and benefits. The EIA process identifies ways of avoiding or reducing unacceptable impacts and shaping the project to suit its environment. The process is predictive and must ultimately produce a decision-making tool. The incorporation of an EIA into project design facilitates progress towards sustainable development.

The main objective of this project is to provide the Trekkopje mine with a tarred access road that optimises relevant biophysical, social, technical and economic parameters.

At present the mine access road is from Trekkopje siding on the B-2 from Swakopmund to Windhoek. The original road was established to provide access to the Annaberg Tin Mine. The distance from Trekkopje siding to the mine is 40 km. TABLE 1.2 shows the distance from Arandis to the Trekkopje mine main gate along the current roads and along the proposed mine access road. The road is currently maintained by AREVA through regular grading and is accessible to general traffic, including trucks and buses.

TABLE 1.2 – DISTANCE CHART		
From	**To**	**Approximate km**
Swakopmund	Arandis	37
Arandis	Trekkopje rail siding	19
Trekkopje rail siding	Mine main gate	40
	Total	**59**
Arandis	Mine main gate via pipeline	30

1.6 Project Justification

The principle justification of the project is to optimize travelling time, carbon emission through fuel consumption and safety of employees and the general public. In this regard, AREVA undertook a review of the access road alignment. Road accident rates are directly proportional to distance travelled (i.e. longer roads are likely to result in greater numbers of accidents, all other parameters being equal). Consequently, a more direct route to the main mining area that runs directly from Arandis has been selected as the proposed alignment of the new access road. The route follows the existing temporary water pipeline that supplies the mine from the Rössing Terminal Reservoirs near Arandis. This road will not only reduce the total number of kilometres travelled by staff and contractors between the mine and Swakopmund but will also reduce the number of kilometres travelled by them on the national road, thereby reducing traffic volumes.

To comply with Namibian legislation, international best practice, the requirements of the Equator Principles, an EIA is required for the construction and operation of a new access road. The principle justification for the ESIA process is to provide the regulating authority and Interested and Affected Parties (I&AP's) with the necessary information to assess the project and its related impacts.

1.7 Benefits for and Impacts on the Region

AREVA's proposed new mine access road from Arandis to the Trekkopje mine will make a substantial contribution to economic development in Namibia as a whole and specifically to the Erongo Region, where the operation will be located. A brief summary of the benefits that can be expected to accrue to the region are:

- Stimulation of the local economy through employment creation and the growth of secondary and service industries;

- Development of the tourism potential of the //Gaingu Conservancy through the provision of capacity, skills transfer and resources;
- Poverty alleviation in the Spitzkoppe community through the growth and support of appropriate economic activities and assistance with the development of the Spitzkoppe community campsite;
- Development of infrastructure;
- Increased local rates and taxes to the Town Councils of Arandis and Swakopmund;
- Growth in the industrial and residential property market and the establishment of businesses in Arandis; and
- An increase in skills training to meet the demands of the mine and secondary industries and a consequent raising of skills levels.

Liabilities that may be anticipated and need to be addressed through management plans include:

- Environmental impacts, including potential pollution, environmental degradation and disruption of ecosystems over large areas;
- Increased demand for and use of natural resources, including water;
- Potential social dislocation;
- Unsustainable economic development in Arandis; and
- Changes in land use.

The alignment of the mine access route has important implications. These can be summarised as follows:

- Biodiversity: The project is located in the hyper-arid Central Namib, a desert area with high levels of endemism and fragile ecosystems. Construction of access routes is likely to negatively impact on rare species.
- Landscape dissection: The project lies within the //Gaingu Conservancy, a wilderness area set aside for community-based natural resource management. The low agricultural potential of the area restricts conventional agricultural activities and consequently, the primary potential benefit to the community arises through conservation and ecotourism. These activities can be adversely affected by heavy traffic and industrial servitudes.
- Social impacts: Two of the proposed access routes pass in close proximity to the town of Arandis. The increased presence of truck drivers, mine employees and contractors may result in increased levels of social ills such as alcohol and substance abuse, as well as prostitution. Increased traffic may disrupt the social fabric of the town.
- Health and safety: One of the proposed access routes is longer than the other two. It also requires more kilometres travelled on a national road. The potential for accidents (motor vehicle and pedestrian) is thus higher. The other two routes both

pass close to Arandis and could potentially increase pollution levels experienced by the town.

- Carbon emissions: One of the routes is more direct than the other two and will result in considerable reductions in carbon dioxide emissions from vehicles.
- Operational expenditure: One of the routes is more direct than the other two and will result in considerable reductions in fuel consumption.

1.8 Introduction to the Project Setting/Regional Environment

The Trekkopje mine is situated 70 km north-north-east of Swakopmund, and lies within an area covering 37,000 ha. The Rössing Uranium mine lies 35 km south of the property and the Langer Heinrich Uranium mine lies 81 km to the south-south-east within the Namib-Naukluft Park.

The mining tenement and the proposed road occurs within the //Gaingu Conservancy, which is communal land held in trust by the State for the benefit of the Namibian people, particularly for the advancement of rural communities. No settlements occur on the proposed road route, which will traverse what can be considered as wilderness lands, only rarely used for temporary grazing.

1.8.1 Location: regional and local maps

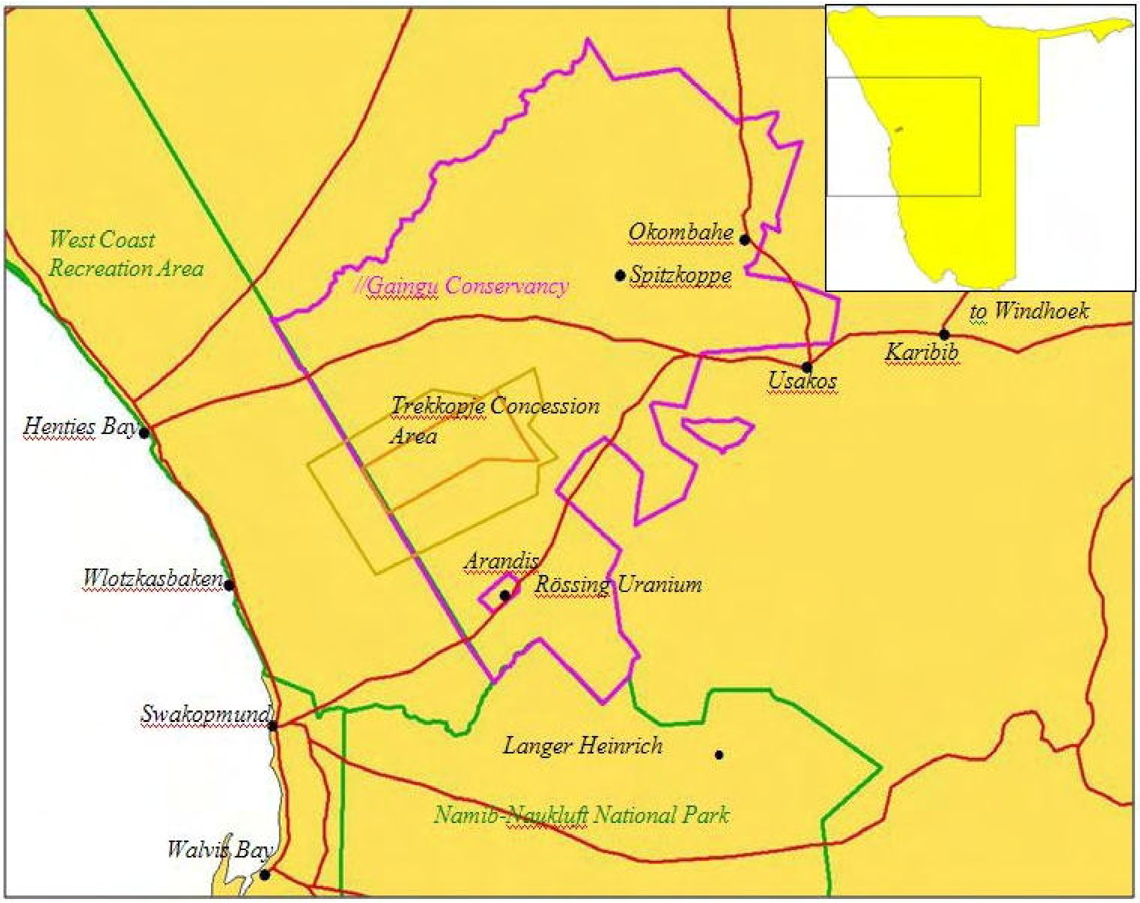


FIGURE 1.1 – PROJECT SETTING

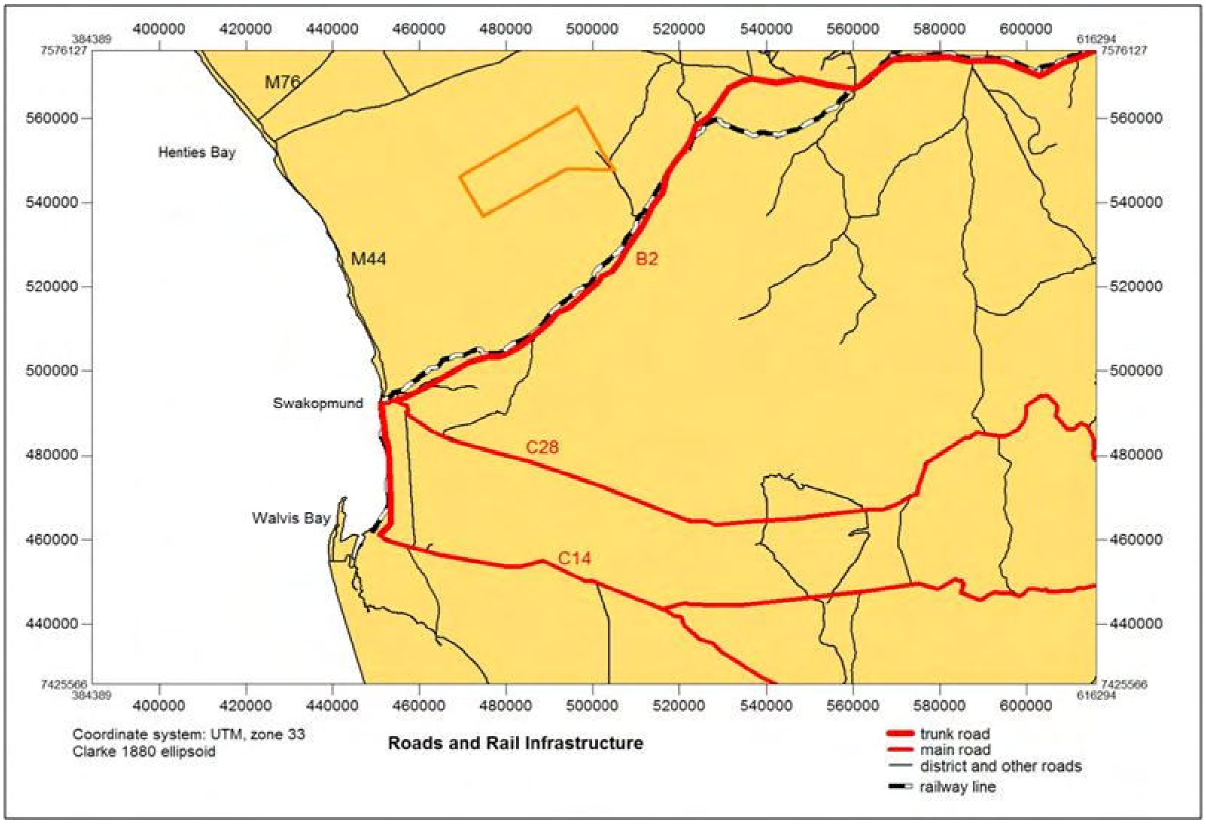


FIGURE 1.2 – EXISTING TRANSPORT INFRASTRUCTURE

1.8.2 Biophysical environmental setting

The Trekkopje Project is located in the hyper-arid Namib Desert. Hot dry conditions during the day and cool nights are common. There is no surface water on the site, except during rare periods of exceptional rainfall. Major rivers in the region such as the Swakop River flow less than five times in a decade. Limited ground water resources are present on site.

Trekkopje lies in the Central Namib vegetation zone. Desert environments are typically very sensitive to disturbance and require long recovery times. For this reason, and the presence of many endemic species, careful management of the sensitive ecosystems through which the proposed road will be constructed is required. Rare and keystone species require particular attention. Topographic high points commonly support greater levels of biodiversity than the surrounding planes and will be avoided where possible.

Much of the land surface is covered by a delicate salt crust formed by fog moistening the surface layer. Dust generation can be significant when the surface is disturbed.

1.8.3 Economic

The Erongo Region has the second highest income per capita in the country after the Khomas Region. The relative prosperity of the region is derived from fishing, mining and tourism. The Region has good access to the infrastructure necessary for economic development. The harbour at Walvis Bay recorded positive growth during recent years, and is one of the key economic features in the region. The Walvis Bay Corridor connects the harbour to the rest of Southern Africa via the Trans-Caprivi and Trans-Kalahari Highways.

Potential for agricultural development is believed to lay in the commercial exploitation of non-traditional, high value agricultural products. Industrial activity is limited and based on fish processing, concentrated in Walvis Bay. Small/Medium Enterprise (SME) activity is similarly limited and is concentrated mainly in trade and services and, to a lesser extent, in manufacturing (which includes beer/liquor brewing).

Rössing, the Navachab gold mine and the coastal salt operations were, until recently, the only significant mining activities in the Region. A substantial increase in the uranium price has resulted in a number of new uranium operations in the Erongo Region. There is also an increasing volume of tourism through the Erongo Region which forms an important link between two popular tourist destinations – the Etosha National Park and Sossusvlei. The majority of those engaged in economic activity in Erongo are in wage employment. This means that the labour force is highly vulnerable to non-employment.

1.8.4 Social

The nearest town to the proposed mine access routes is Arandis, which is situated approximately 30 km due south of the Trekkopje license area. This community will potentially be most affected by the proposed development.

Arandis is a mining town, originally established to house the workforce of Rössing Uranium. Its economy has long been dependant on mining. Unemployment is high, and many households have little or no income. There are a large number of woman-headed households, as well as some households headed by children. Marginalised groups include women, children, the youth and the elderly. State health services are minimal. Education is well provided for however and the town houses a highly-regarded training institute.

Economic, natural and social capital has steadily been eroded, and the Arandis Town Council's (ATC's) financial situation is precarious, largely due to the failure of the citizens to pay for services. The ATCI depends on government grants for capital funding, as little revenue is generated locally.

1.9 Existing Biophysical Impacts and Potential for Cumulative Impacts

The consequences of cumulative impacts can be both positive and negative. Cumulative development benefits can be significant (e.g. the development of Arandis as a result of uranium mines). Negative impacts can reinforce each other resulting in excessive dust, water consumption, pollution and social dislocation.

The term cumulative impact refers to an impact occurring in a receiving environment that is experiencing, or has experienced, similar impacts, regardless of whether these impacts are the result of the actions of one or a number of agencies. The assessment of the impact is arrived at by comparing the impact of the combined effect of the actions to the capacity of the receiving environment to withstand or recover from the impact. It involves all environmental components, including the socio-economic environment; the latter particularly with regard to Community-Based Natural Resource Management (CBNRM) and the potential for poor, rural communities to earn livelihoods through exploitation of the resource base for tourism. Cumulative impacts are discussed further in Chapter 8.

Several impacts have historically occurred in the environment surrounding the proposed road project. Expansion of nearby cities and towns and intensive use of fragile desert surfaces for eco-tourism can also result in negative environmental impacts.

Large scale uranium mining already occurs in the region, at Trekkopje mine, Rössing Uranium and at Langer Heinrich (see FIGURE 1.3) and several exploration companies are prospecting nearby. These activities increase dust loading in the atmosphere and removal of water from aquifers.

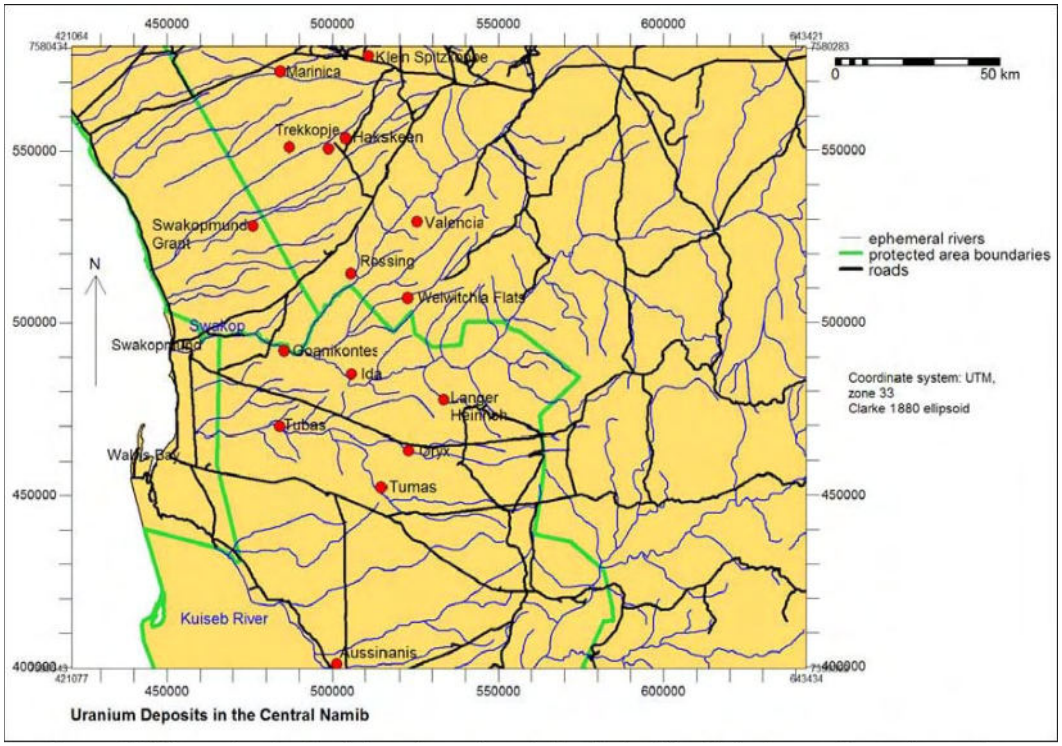


FIGURE 1.3 – CURRENT AND POTENTIAL URANIUM MINES IN THE CENTRAL NAMIB

2 BACKGROUND

2.1 Name and Address of Proponent

TABLE 2.1 – PROPONENT DETAILS	
Name of Proponent	**Address of Proponent**
AREVA Resources Southern Africa	Block A 204 Rivonia Road Morningside Gauteng South Africa 2057
AREVA Resources Namibia	Corner of Otavi & Leutwein Streets Swakopmund Namibia

2.2 Locality

FIGURE 2.1 shows the three alternative routes. Alternative 1 – Current Access road leads off the B 12 at the Trekkopje rail siding. Alternative 2 & 3 both start at the town of Arandis.

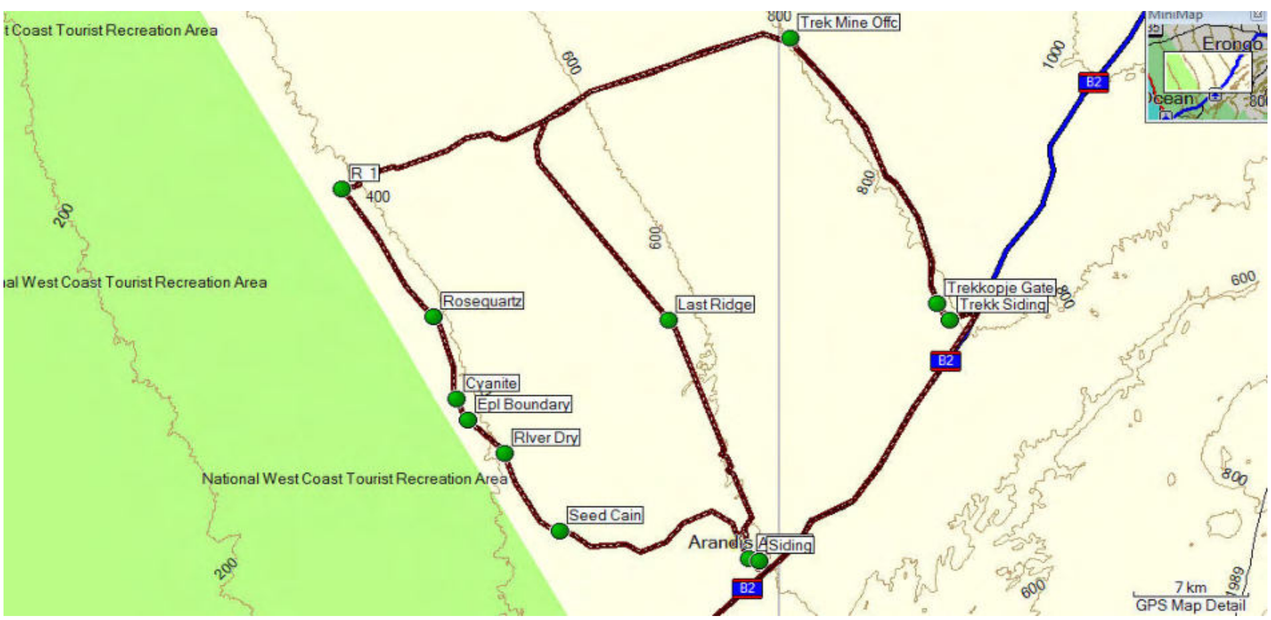


FIGURE 2.1 – ALTERNATE ROAD ACCESS ROUTES

2.3 Magisterial District and Regional Services Council Authority

The Trekkopje Mine is situated in the Swakopmund and Usakos Magisterial Districts. The regional services council authorities that support the Trekkopje Mine are the Erongo Regional Council.

2.4 Surface Infrastructure

The surface infrastructure includes a temporary water pipeline which was established from Arandis to Trekkopje mine in order to supply the initial requirements of the mine. Other infrastructure includes the current access road to the Trekkopje Mine (see FIGURE 2.2).

FIGURE 2.2 – CURRENT ACCESS ROAD TO TREKKOPJE MINE

2.5 Presence of Servitudes

Off-site servitudes

The Trekkopje mine requires access over the land adjacent to the mine. This means that impacts arising from land use change outside the mining tenement need to be considered. Selecting the optimum access route for the mine is part of the scoping component of this EIA process.

2.6 Land Use

The alternate access routes traverses land under the jurisdiction of the Arandis Municipality and communal land under the authority of the Oe#Gan Traditional Authority. The #Gaingu Conservancy is situated in this communal land, and will be traversed by the proposed access road.

2.7 Surrounding Land Use

Mining activities account for a significant portion of land-use in the Erongo Region.

Communal and commercial land uses near the site include tourism at Spitzkoppe. There is a camp site at this location, which offers a variety of eco-tourism options. Rock art at Bushmen's Paradise has been declared a national monument.

Two types of farmers are active in the Erongo Region, i.e. communal farmers and commercial farmers. Communal farmers are involved in small-scale production for their own consumption or for sale at the local, often informal, markets. There are currently no farming activities along the proposed road access route, but the area is communal land and, as such, available for seasonal grazing and settlement with the approval of the Traditional Authority.

3 REGULATORY SETTING

3.1 Key Legislative and Administrative Requirements

The Ministry of Environment and Tourism (MET) is the custodian of Namibia's natural environment and discharges this duty via environmental regulations. The MET is thus the lead agent for EIA studies.

This EIA is being undertaken in accordance with the Environmental Management Act (No. 7 of 2007) and the Draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management Plans (No. 1 of 2008).

3.1.1 The Environmental Management Act (No. 7 of 2007) (EMA)

The overarching objective of the EMA is to promote the sustainable management of the environment and the use of natural resources, by establishing principles for decision making on matters affecting the environment.

The Environmental Management Act, 2007, (Act No. 7 of 2007) sets out the principles of environmental management as follows:

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

b) *Community involvement in natural resource management and the sharing of benefits arising from the use of 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 these systems and to prevent harmful effects;*

e) *Assessments must be undertaken for projects which may have a significant effect 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) *To reduction, re-use and recycling of waste must be promoted. 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;*

j) *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*

k) *Damage to the environment must be prevented and activities which cause such damaged must be reduced, limited or controlled.*

3.1.2 The Water Resources Act (No. 24 of 2004)

The Act makes provision for a number of functions pertaining to the management, control and use of water resources, water supply and protection of water resources. The Ministry of Agriculture, Water Affairs and Forestry (MAWF) is responsible for conservation and utilisation of these resources. A distinction is made between private and public water in terms of ownership, control and use. The Act recognises the natural environment as a water user.

3.1.3 National Heritage Act (No. 27 of 2004)

Archaeological resources are protected in Namibia under the National Heritage Act (No. 27 of 2004), which makes provision for mandatory archaeological impact assessment in the event of likely damage to archaeological sites.

3.2 International Best Practice

AREVA subscribes to the Equator Principles in its environmental and social undertakings. The Equator Principles require an EIA to address the following:

- Assessment of baseline environmental and social conditions;
- Requirements under host country laws and regulations, applicable international treaties and agreements;
- Sustainable development and use of renewable natural resources;
- Protection of human health, cultural properties and biodiversity, including endangered species and sensitive ecosystems;
- Use of dangerous substances;
- Major hazards;
- Occupational health and safety;
- Fire prevention and safety;
- Socio-economic impacts;
- Land acquisition and land use;
- Impacts on indigenous peoples and communities;

- Cumulative impacts of existing projects, the proposed project and anticipated future projects;
- Participation of affected parties in the design, review and implementation of the project;
- Consideration of feasible environmentally and socially preferable alternatives;
- Efficient production, delivery and use of energy, and
- Pollution prevention and waste minimisation, pollution controls and solids and chemical waste management.

4 METHODOLOGY

4.1 Phases of the Environmental and Socio-economic Impact Assessment (ESIA)

The ESIA is essentially divided into two phases, namely; the scoping/screening phase and the impact assessment phase. Within each phase Interested and Affected Parties (I&APs) are given the opportunity to participate in the process by being provided with information pertaining to the project. This information will be made available through public meetings, access to web sites with project documents and physical and electronic access to documents. Stakeholders are encouraged to submit comments to the public participation manager. Figure 4.1 shows the EIA project life cycle.

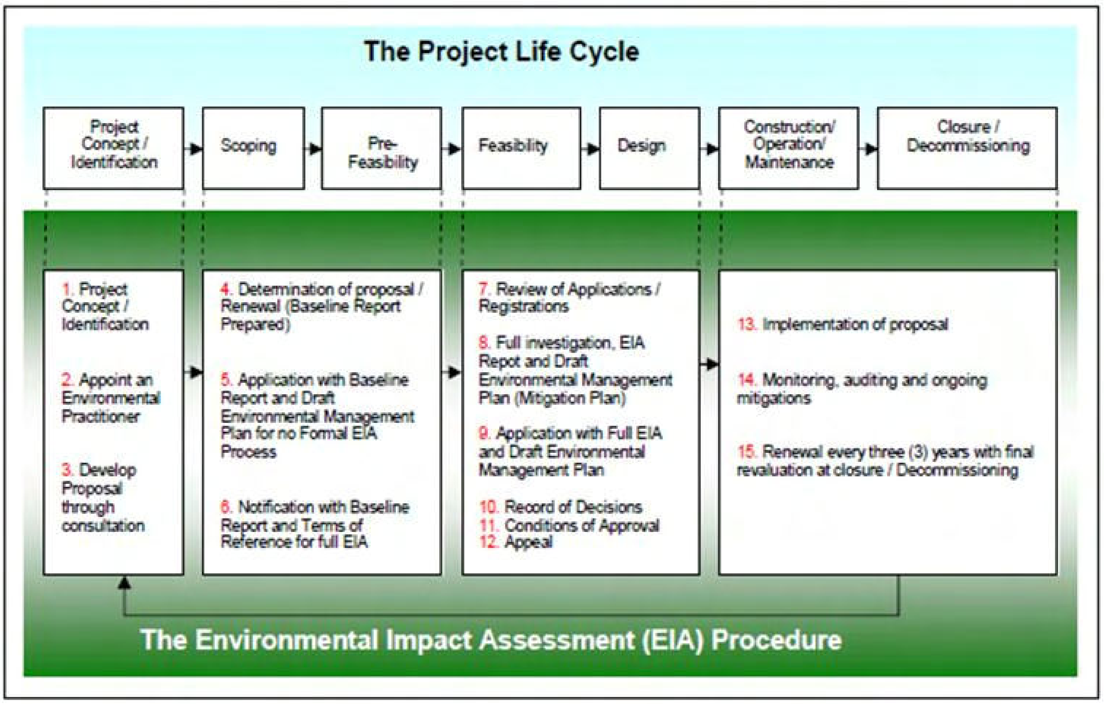


FIGURE 4.1 – THE EIA PROJECT LIFE CYCLE

4.1.1 Detailed alternatives assessment and trade-off study

A preliminary trade-off study as part of the scoping process was undertaken by the project team in order to determine the feasibility of the project and to uncover any potential fatal flaws prior to commissioning a full investigation. The detailed alternatives assessment and trade-off study has been completed using a Multiple Accounts methodology. The methodology and results of the study is described in full in APPENDIX III.

4.1.2 Scheduling of the EIA

The Trekkopje Mine Access EIA commenced in April 2009. Comments from the public meeting and stakeholder consultation were incorporated into the Scoping Report and then submitted to the authorities for review. After a one month review period the authorities accepted the report without requiring further scoping processes and the project then moved into the impact assessment phase. This phase includes the necessary specialist studies. The EIA is scheduled for completion by the end of November 2009.

4.1.3 Phase 1 – scoping

The following stages are required in terms of the Draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management Plans Act (No. 1 of 2008):

Stage 1 – Project Identification: During the identification stage the proponent shall determine whether or not a proposed project or modification to an existing project is likely to have significant environmental effects. The proposed Trekkopje Mine access road is a new project with a significance that requires the full EIA process.

Stage 2 – Appointment of Environmental Assessment Practitioner: AREVA has appointed Turgis Consulting (Pty) Ltd to undertake the assessment process. Turgis Consulting undertook the Trekkopje Mine ESIA [1] as well as the Desalination Plant and Mine Water Supply Pipeline ESIA.

Stage 3 – Develop a Project Proposal: This stage has been completed. A Background Information Document has been circulated and issues and alternatives have been investigated.

Stage 4 – Determination of Proposal: It has been determined that the project may have significant impacts and therefore the full EIA process is required. The baseline report and assessment of alternatives and preliminary identification of impacts forms part of this report.

Stage 5 – Application (No significant Impact): Not applicable to this project.

Stage 6 – Notification: Stage 6 is the first stage at which the proponent formally contacts / notifies the competent authority on the intentions to undertake a full EIA

[1] ***Environmental & Social Impact Assessment***

for a project proposal determined to have significant impact. This has been undertaken by the submission of the Scoping Report to the MET on 19 August 2009.

Stage 7 – Review: The competent authority has reviewed the documents and provided approval to continue with the impact assessment phase of the project.

4.1.4 Phase 2 – impact assessment and specialist studies

Stage 8 – Full Environmental Impact Assessment and Management Plan: This report forms part of this stage.
Stage 9 – Application (Significant Impact)
Stage 10 – Record of Decision: To be provided by the MET.
Stage 11 – Condition of Approval: To be provided the MET.
Stage 12 – Appeal Process: The decision-making process provides an opportunity for appeal through the Minister. Besides appealing to the decision-making authority, appellants have the right to legal recourse.
Stage 13 – Implementation

4.1.5 Phase 2.1 – specialist studies

During the detailed and exhaustive Environmental Impact Assessment for Trekkopje Mine a number of specialist studies were undertaken. These studies included specific assessments of the impacts of the temporary mine water pipeline from the Rössing reservoir in Arandis to Trekkopje Mine.

The following specialist studies were commissioned as part of this EIA process to validate the previous assessment, to identify if any changes have taken place, to determine the additional impacts the proposed road may have and to make recommendations for mitigation:

- Biodiversity (fauna & flora).
- Heritage.
- Noise.
- Social Impact Assessment.
- Detailed road design.

4.2 Alternatives Assessment and Trade-Off Study Predictive Methods Employed

The multiple accounts methodology used in the assessment and trade-off of various project components is detailed in APPENDIX IV.

4.3 Impact Assessment Predictive Methods Employed

The methodology used in the assessment of impacts is detailed in APPENDIX II.

4.3.1 Assessment criteria

Environmental impacts arising from road development projects fall into three basic categories:

i) Direct impacts;
ii) Indirect impacts; and
iii) Cumulative impacts.

These three groups can be further broken down, according to their nature, into;

- Positive and negative impacts;
- Random and predictable impacts;
- Local and widespread impacts;
- Temporary and permanent impacts; and
- Short- and long-term impacts.

A detailed description of impacts is provided in APPENDIX II.

4.3.2 Cumulative impacts

A cumulative impact can be described as an impact which:

- Occurs in a receiving environment which is experiencing, has experienced, or in the future may experience similar impacts in the future;
- Where the potential for synergistic interaction between impacts (i.e. the net impact is greater than the sum of component impacts); and/or
- Where ecological or social thresholds may be breached by a number of consecutive or simultaneous impacts, which individually may have not resulted in impacts.

5 PROJECT DESCRIPTION

5.1 The New Access Road

The proposed new access route will be a bitumen surfaced two-lane road starting from Arandis rail siding and ending at the, to be constructed, Maxi pad at Trekkopje Mine. The road will closely follow the current temporary water supply pipeline that supplies the mine with water from Rössing reservoir. The new road will be a private road for mine vehicles only, with a security check point at Arandis – no public access will be allowed as AREVA will be operating large "road-train" transport vehicles.

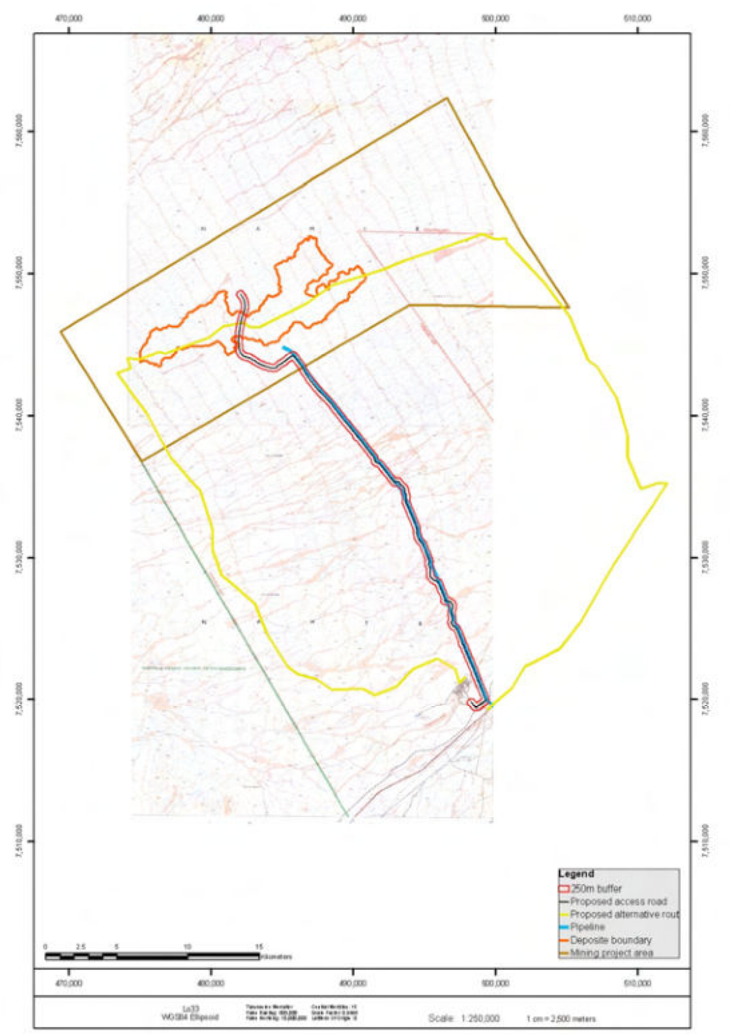


FIGURE 5.1 – THE NEW ACCESS ROAD ROUTE

The new access road will be a "dead-end" destination as the route will not link to any additional road in the vicinity.

5.2 Road design

The proposed road will have a bitumen surface and be 7.6 m wide (with a 1.5 m gravel shoulder on either side). Each driving lane will be 3.5 m wide with 300 mm allowed for painting of yellow lines. The road may at certain locations, where required, be raised to between 1 and 1.5 m above ground level in order to remain within the road profile. The road will be constructed to Namibian and international standards and will be designed to carry heavy vehicle traffic at speeds of up to 80 km/h.

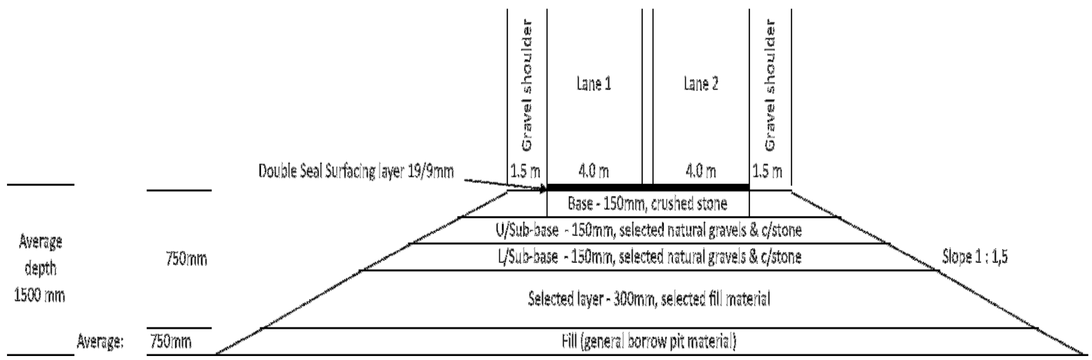


FIGURE 5.2 – ROAD DESIGN

The machinery to be used will include compaction equipment, graders, bulldozers, tipper trucks, front-end loaders, rollers and concrete and bitumen mixers.

5.3 Water Supply and Reticulation

Water requirements for the road construction will come from the existing temporary mine pipeline. This temporary pipeline extends from Rössing Reservoir in Arandis to Trekkopje Mine. The road route closely follows the temporary pipeline which currently has a 4x4 gravel track adjacent to it.

5.4 Landfill

A proposal was mooted to excavate the first borrow pit needed for fill material relatively close to Arandis. The pit would then be excavated and designed in such a manner that it could be used in future as a landfill site for general waste. This would provide the town of Arandis and surrounding mines with a disposal site for waste and thereby allow for effective control of windblown litter. However, more detailed investigation is required to fulfil this aspect as the surface material suitable for fill in close proximity to Arandis is very shallow (approximately 20 – 50 cm deep) and would therefore serve no purpose. The possibility does exist that crusher material required for the sub-base layers could be excavated in the area. This aspect needs detailed geological and geo-chemical testing in order to determine the availability of suitable material.

5.5 Infrastructure

The Arandis road and rail siding terminal will be upgraded and developed to accommodate the transport and handling of all mine related materials and products. The intention is to transport material by rail to Arandis where it will be cross-loaded onto road trains and transported via the new road to Trekkopje Mine.

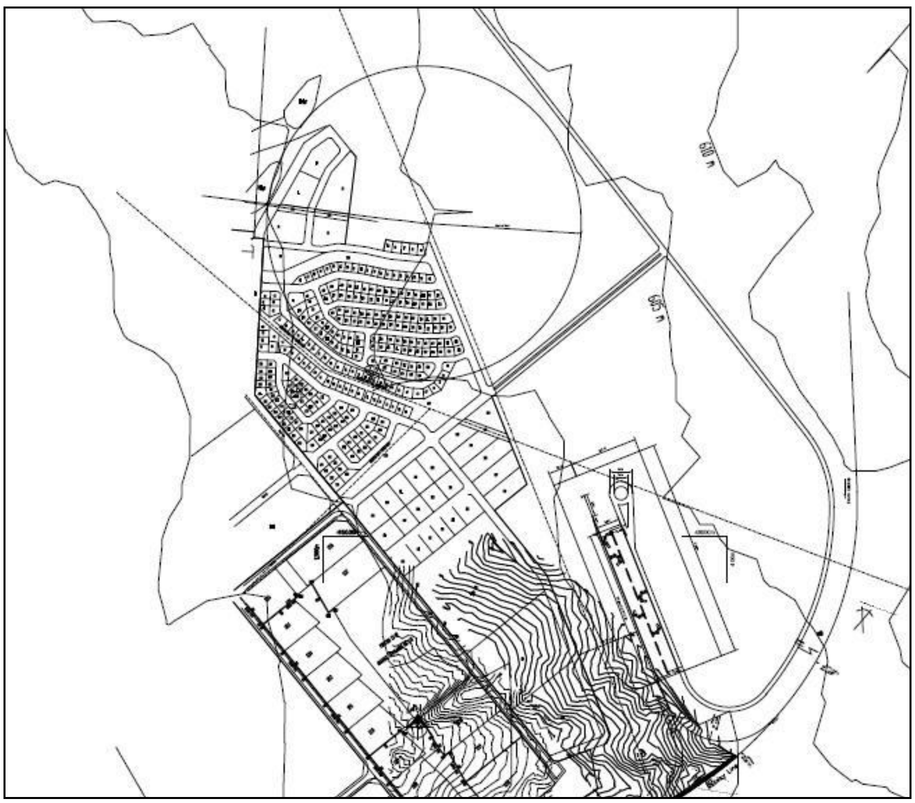


FIGURE 5.3 – PROPOSED NEW ROAD DEVELOPMENT

Concentrate from the mine will be loaded into standard IP2 drums weighing up to a maximum of 450 kg each. All drums will be dated and marked with the weight of concentrate and the lot number. These drums will then be placed in a standard 6m container. The loaded containers, complete with all of the required documentation, will then be shipped by truck to the Walvis Bay port for shipping to the designated conversion plant.

5.6 Borrow Pits

Construction for the proposed new access road requires the use of fill material that will principally be sourced from two avenues; borrow pits and suitable mine overburden material. An additional source of fill material is from cutting V-sections through ridges and filling the required areas with the material. This form of material source alters the natural relief and morphology of the landscape permanently and therefore has been discarded as an option for the Areva road. The formation of major cut and fill zones will be extremely difficult to rehabilitate and will be out of character with the terrain.

Bitumen surfaced roads require large amounts of fill material in various layers and thicknesses. These layers are required to provide a stable platform to carry the intended loads and for the integrity of the road to remain intact under such loads and use conditions. Where the road crosses over drainage lines, washes and dry riverbeds concrete structures are placed to divert and channel the water. The borrow pit material is required to fill the voids in order to remain within the profile of the road.

The proposed road from Arandis to Trekkopje Mine would require an estimated total of 608 000 m³ of various forms of fill material.

FIGURE 5.4 – BORROW PIT ON CURRENT ACCESS ROAD

5.7 Road transport

The main chemicals to be transported to Trekkopje consist of reagents for ore processing, explosives and fuel. The expected quantities to be transported are as follows:

- Soda ash and sodium bicarbonate - rail: 1 train per day from Walvis Bay to the proposed Arandis road & rail siding terminal carrying up to 46 x 22 ton bulk powder ISO-veyors (gross), 7 days per week.
- Soda ash and sodium bicarbonate – road: up to 8 full and 8 empty road trains per day from the Arandis road & rail siding terminal to the Trekkopje mine site carrying up to 6 x 22 ton bulk powder ISO-veyors (gross), 7 days per week.
- Caustic soda liquid – rail: from Walvis Bay to the Arandis road & rail siding terminal carrying up to 7 x 32 ton bulk liquid ISO-tanks (nett), 7 days per week.
- Caustic soda – road: up to 4 full road trains per day from the Arandis road & rail siding terminal to the Trekkopje mine site carrying up to 2 x 32 ton bulk liquid ISO-tanks (nett), 7 days per week.
- 70% hydrogen peroxide liquid – road: by flat-bed road truck and trailer from Walvis Bay to the Trekkopje mine site carrying only 1 x 23 ton bulk liquid ISO-tank (nett), once every 8 days.
- 98% sulphuric acid liquid – road: by liquid bulk road tanker from Walvis Bay to the Trekkopje mine site carrying 32 tons load (nett), once every 6 days.
- 30% hydrochloric acid liquid – road: by bulk liquid road tanker from Johannesburg direct to the Trekkopje mine site carrying 32 tons load (nett), once a month.

FIGURE 5.5 shows a typical road train to be used on the Trekkopje project. These vehicles may only be used on private roads due to safety considerations.

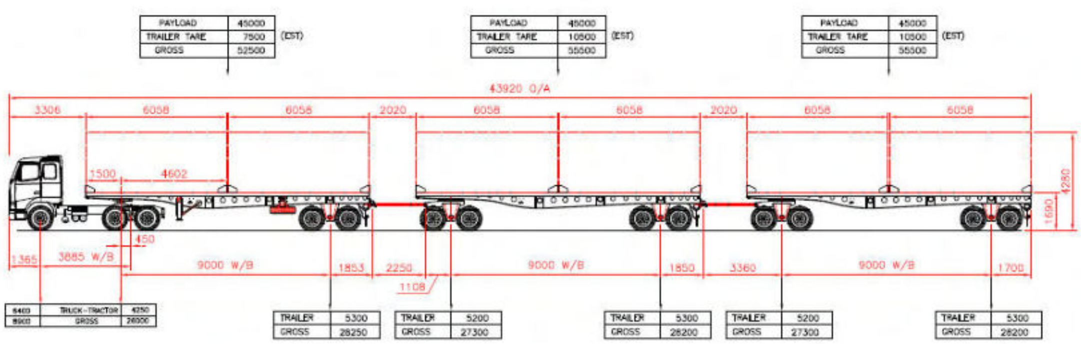


FIGURE 5.5 – ROAD TRAINS

TABLE 5.1 below shows the average vehicle movement for the month of July 2009 using the current mine access road from Trekkopje siding.

TABLE 5.1 – MINE TRAFFIC JULY 2009	
Vehicle	Average number of trips for the month
Light Delivery Vehicle (1 person)	941
Light Delivery Vehicle (More than 1 person)	1299
Mini bus	87
Large bus	504
Truck	80

At present the Trekkopje operation is in construction phase, therefore no product is being exported off the mine site. Busses are used to transport mine personnel on a 24-hour shift basis from Swakopmund and Arandis and travel both directions with a full compliment.

5.8 Schedule

On completion of the regulatory process and a positive record of decision is received to continue with the development of the road the detailed design phase will commence. This phase will entail the following aspects:

- Surveyoring the rote for setting out and establishing the construction beacons.
- Detailing the borrow pits which will include material testing for suitability and availability.
- Undertake geological and geotechnical invetigations on the proposed route.
- Preparation of final designs inclusive of all calculations, drawings, specifications, engineering schedules of quantities and proclamation sketches in accordance with the requirements of current appropriate codes, manuals and guidelines.
- Designing of the road based on guidelines in terms of speed, loads, and traffic volumes.
- The internationally recognised COLTO Standards Specifications will be used.

On completion of the detailed design phase the tender and physical construction phases will commence. It is expected that the entire process will take approximately 14 – 18 months to complete.

6 OVERVIEW OF SCOPING PROCESS

6.1 Introduction

The scoping process of the Trekkopje Mine Access Road EIA included review of the biophysical and social baselines. These reviews highlighted a number of potential impacts that may occur as a result of the construction of the mine access road. The synopsis of findings at the end of this section describes the detailed assessments required during the EIA Phase in order to determine the nature and severity of the impacts, as well as mitigation measures to be included in the Environmental Management Plan.

6.2 Review of Biophysical Baseline

The central Namib is an area of very high endemism with many rare and protected species such as Larryleachia and lithops. Additionally, the region is of archaeological importance, with significant densities of well preserved sites representing key periods in the Pleistocene-Holocene sequence.

The route of the proposed mine access road proceeds North-North-West towards the mine tenement from Arandis (see FIGURE 6.1). It crosses uneven terrain of ranges of low hills, rocky ridges and numerous washes. The rocky ridges and washes lie at right angles to the route, which is consequently very undulating. The Arandis area is criss-crossed by a dense network of tracks, with dumps of building and industrial refuse in various places. Between Arandis and the southern boundary of the Trekkopje tenement the route traverses a series of prominent schist, dolerite and marble ridges, more or less across strike. Within the tenement, the route follows a network of existing tracks across a wide gravel plain with well developed drainage lines. The terrain along the route is relatively undisturbed by tracks and other impacts, except within the tenement and near Arandis. Around Arandis, off road driving is completely uncontrolled.

The area traversed by the proposed access route can be provisionally [2] subdivided into two zones which separate at S 22°18'54"; E 14°57'17". The southerly zone is rocky with numerous marble and dolerite ridges and the northerly zone comprises open plains with numerous drainage lines and only occasional rocky outcrops (see FIGURE 6.1). The composition of vegetation communities differs somewhat between the southern and northern zones.

[2] This division may change once the detailed specialist study results become available.

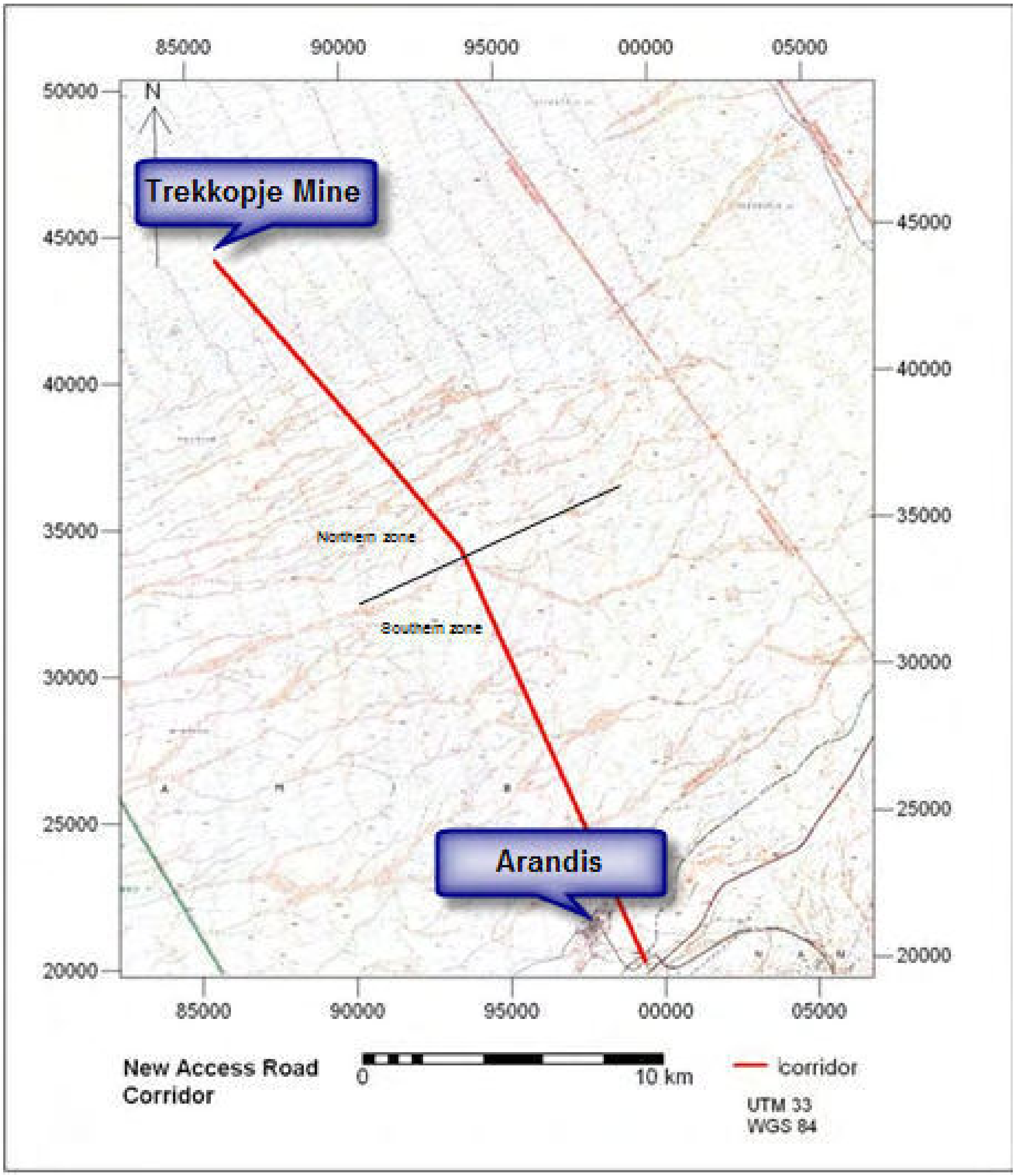


FIGURE 6.1 – PROPOSED CORRIDOR FOR THE NEW ACCESS ROAD

FIGURE 6.2 – VEGETATION DIVERSITY ON A TOPOGRAPHIC HIGH POINT (Aloe Asperifola and Commiphora Spp. Visible)

6.2.1 Climate

The Central Namib consists of a flat, gently sloping plain with few topographic features. Because of this, the steady gradients affect rainfall, fog, humidity, temperature and wind patterns developing between the coast and the interior. There are no pronounced seasons in the Namib and the average temperature and humidity do not vary significantly throughout the year. The annual mean rainfall of the Namib Desert ranges from 5 mm in the west to about 85 mm in the east. Wet years with in excess of 100 mm of rainfall (maximum 115 mm) are very rare nearer the coast and have been recorded only in 1934, 1976 and 1978. Fog, a more reliable and predictable occurrence in the western Namib than rainfall, is frequent and extends up to 110 km inland from the coast. The coastal fog provides life-supporting moisture to a high diversity of fauna and flora in this arid environment.

Potential evaporation increases steadily from the coast inland and exceeds precipitation by 10 - 60 times. In the Central Namib, winds with speeds greater than 2 m/s prevail for 70 - 80 per cent of the time and can occur at any time of day. The highest average annual wind speeds are recorded in the hours between 12h00 - 20h00. Berg wind conditions occur annually when low winter temperatures inland create continental low pressure systems. These hot, desiccating winds can inhibit rehabilitation of disturbed surfaces and may represent a sand-blasting hazard.

Average annual air temperature increases from the coast (15° C) to the escarpment (22° C) without strong seasonal variation. The Trekkopje/Arandis area is thus hot and dry with day temperatures reaching up to 50°C and nights cooling to as low as 0° C. Due to the proximity of the coast, frost is a rare occurrence at the site. The sun shines for 84 per cent of all daytime hours in the interior, compared to 47 per cent at the coast.

6.2.2 Potentially threatened habitats [3] – fauna and flora

Namibia is home to a remarkably high biodiversity, notably among its plant species. Within its borders, more than 4,500 plant species have been recorded, of which 275 are Namib Desert endemics shared with southern Angola. A unique array of biodiversity exists in the Namib, with high levels of endemism and numerous advanced adaptations to arid conditions. Many of these endemic and near endemic plant species have restricted distribution or habitat, making them extremely vulnerable to disturbance.

The western parts of the Trekkopje area consist of vast gravel plains that are largely devoid of vegetation except for at least 70 percent coverage with lichens. East of the lichen plains, a vegetation strip with randomly distributed shrubs occurs. The lichens disappear in this strip. From this strip towards the east, open gravel plains become more vegetated with annuals and grass species. Shrubs occur along the drainage lines in these areas. Trees such as *Acacia erioloba* and *Euclea pseudebenus* occur in the ephemeral rivers.

The north-west escarpment area, which includes the Trekkopje area, is rich in insect, reptile, mammal and bird species diversity. Compared to reptiles and arthropods, mammals are generally not well represented in true deserts for a number of reasons, most importantly, the lack of water.

An estimated 63 species of reptile, 6 amphibian, 52 mammal and 126 bird species occur in the general Trekkopje area, of which a high proportion is endemic. The Namib Desert is also known for its high species richness of beetles, particularly those belonging to the family Tenebrionidae. Many of these have evolved methods of condensing fog as a source of water.

[3] This section is based on field data gathered by Henschel, Pallett, & Seely (2007)

6.2.3 Air quality

Given the desert environment and the prevailing winds, particularly the north easterly winds blowing between April and September, ambient levels of dust are likely to be high. At present there are no significant human activities in most of the area traversed by the proposed access route. Furthermore, natural crusting of the soil minimises the frequency of windblown dust, even at moderate wind speeds. Dust on leaves blocks stomata and lowers the plant's ability to photosynthesize. Therefore it is not only important to view the impacts of dust on the human population within the confines of the construction area and region but also on the sensitive flora and faunal ecosystems that surround the area.

Air quality is affected by dust (during construction) and by exhaust fumes. The proposed route is shorter than the existing access route which may ultimately result in reduced volumes of exhaust fumes. The pipeline route and the quarry route are located near to Arandis and so have a potentially greater impact. The analysis showed that the shortest route near to Arandis (pipeline route) and the longest route remote from Arandis (current route) scored the highest in terms of favourability from an air quality perspective.

6.2.4 Geology

The Trekkopje Deposit occurs as a typical Tertiary surface uranium deposit situated on the coastal plain of the Namib Desert, just off the Great Escarpment. The extremely dry climatic conditions prevailing in the Namib Desert preserved the concentration of the highly soluble carnotite, the main uranium-bearing mineral at Trekkopje.

The Trekkopje area is underlain by a thick sequence of schist that is almost 10,000 m thick and has undergone strong metamorphism. Near the Trekkopje tenement, the valley opens up and the landscape is dominated by the typical sediments of the Namib Desert that form a thin cover over the underlying rocks.

The geology traversed by the proposed access route is shown in FIGURE 6.3.

FIGURE 6.3 – GEOLOGY TRAVERSED BY THE PROPOSED ACCESS ROAD ROUTE

6.2.5 Topography

The Trekkopje area is located on a flat coastal plain below the prominent escarpment that separates the Erongo coastal zone from the interior highlands. The plain dips gently towards the coast. The area traversed by the access road corridor is essentially flat with the nett difference in elevation between the southern and northern end points being approximately 80 m. The plains are dissected by numerous dry washes, draining towards the coast. South of the Trekkopje area, ephemeral (dry) rivers run into the Swakop River.

6.2.6 Soils

Soils that form in the Namib are predominantly mineral soils (classified as aridisols). At Trekkopje the soils are composed of raw minerals, which are sandy and at times calcareous, present as particles in a wide range of sizes. Salt crusts are common on soils close to the ocean and thus repeated accumulation of water causes salt layers to form. Due to high evaporation of water in deserts, water is kept close to the surface and is therefore prone to evaporation. Salt has built up in the Trekkopje area when water has evaporated, leaving behind the minerals.

6.2.7 Surface and groundwater

Surface water is only present on site during and immediately after heavy rainfall. Runoff generally occurs as short-lived flows in response to rainfall in the catchment area. Evidence of runoff in the project area is in the form of shallow, sandy, ephemeral, dry riverbeds. Local drainage originates towards the Spitzkoppe area and this, coupled with the very low rainfall of the region, reduces the possibility for substantial ground water resources. The groundwater level is between 10 m and 25 m deep and the groundwater flow is directed towards the west.

6.2.8 Visual characteristics

As the project is located in a sensitive area with high eco-tourism value and many, long, unobstructed views, infrastructure should be designed to blend in with the surrounding landscape where ever possible. Any change in local view sheds, through the introduction of new developments and infrastructure, can be considered as a visual impact. Visual impacts are subjective, and are usually considered most significant when the development is not of similar nature to other developments in the area, is readily viewed from areas of public access, paths, roads and view points, or in areas which are characterized by significant natural features. The sensitivity along the proposed access road is of particular concern when considering the slow environmental recovery rates following physical impacts on the desert ecosystem.

6.2.9 Land/tenure and capability

Mining activities account for a significant portion of land-use in the Erongo Region. The main commodities mined are uranium and gold. Extensive salt mining also occurs along the coast at Walvis Bay. The Namib section, of the Namib Naukluft Park and the National West Coast Tourist Recreation Area, fall within the Erongo Region. The land-use is tourism and conservation. The National West Coast Tourist Recreation Area, in addition to conventional tourist activities, is used extensively for recreational fishing.

Communal and commercial land uses near the site include tourism at Spitzkoppe. There is a camp site at this location, which offers a variety of eco-tourism options. Rock art at Bushmen's Paradise has been declared a national monument.

Two types of farmers are active in the Erongo Region, i.e. communal farmers and commercial farmers. Communal farmers are involved in small-scale production for their own consumption or for sale at the local, often informal, markets. There are currently no farming activities along the proposed road access route, but the area is communal land and, as such, available for seasonal grazing and settlement with the approval of the Traditional Authority.

With regards to land capability, all of the land located on the lower portion of the escarpment/desert transition is considered totally unsuited to any intensive farming practice.

All three of the alternate access routes traverse land under the jurisdiction of the Arandis Municipality and communal land under the authority of the Oe#Gan Traditional Authority. The #Gaingu Conservancy is situated in this communal land, and will be traversed by the proposed access road.

6.2.10 Traffic and transport

The main road network in this region of Namibia is sparse. Arandis is located just off the main road connecting the coastal towns of Walvis Bay and Swakopmund with the interior. Traffic counts received from the Namibian Roads Authority for the section of road between Swakopmund and Arandis (i.e. the B-2) show that the average daily traffic volumes (light and heavy vehicles) in 2007 were 1,842. The counts are directional (eastbound), and it can be assumed that on average, the westbound daily directional volumes are similar.

At this early stage of planning, and dependent on the outcome of the EIA process, the intention is to use the rail network to deliver chemicals, fuel, and miscellaneous materials needed for the mine to the Arandis siding. Thereafter it will be transported by road to the mine.

6.2.11 Background noise levels

The area is sparsely inhabited and the impact of transport and traffic noise is unlikely to be significant.

6.3 Review of Social Baseline

6.3.1 Demographic processes

Demographic processes relate to the number of people and composition of a community. They also include an overview of the population size and the educational profile of the affected communities.

According to the baseline profile that was developed for the EIA on the Trekkopje Mine [4] the total population of the town of Arandis was estimated at around 5,200 people[5]. At the time of the study it was unclear how many households Arandis consisted of and what the profile of a typical Arandis household looked like.

6.3.2 Geographical processes

Geographical processes relate to land use patterns and infrastructure in the area. This section therefore describes the land use in the study area from a social perspective, specifically in terms of settlement patterns and land use developments.

At present it is known that parts of the region (Omaruru, Karibib, and Okombahe/Uis/Tubusiss) fall within a semi-arid farming region and, which is mostly characterised by stock farming, in the form of both communal (subsistence) and commercial farming. In addition, various mining operations are also active within the region, especially around Arandis.

6.3.3 Economic processes

Economic processes relate to the way in which people make a living and the economic activities within that society. The employment status within any given area gives an indication of the economic stability of such an area and also serves as an indicator of such an area‘s general well-being.

The economic growth of Arandis experienced a revival post 2006, mainly due to the global energy crisis that resulted in a significant rise in the demand for uranium. According to the baseline profile for the Trekkopje Mine EIA, the economy of Arandis is mostly dependant on the mining sector, particularly Rössing Uranium. The employment rate was estimated at around 64% in 2005 (which is more or less on par with the employment rate of the region as a whole).

However, it is believed that recent developments in the mining industry, such as Rössing extending their life-of-mine, and the construction of the new Trekkopje

[4] ***Chapter 7: Social & Cultural Baseline; Trekkopje Uranium Project Final ESIA***
[5] ***Based on the Polio vaccine campaign - 2005***

mine, would have created additional employment opportunities. It is, however, unclear whether or not local residents would be able to make use of these new opportunities given the possibility of skills constraints.

Apart from the mining industry, there are a number of community based industries located in and around town, but it is believed that these industries do not make a significant contribution towards the economy of Arandis.

6.3.4 Institutional and empowerment processes

Institutional and empowerment processes relate to the role, efficiency and operation of government sectors and other organisations within the area, in terms of service delivery. It also investigates the ability of people to engage in decision-making processes to such an extent that they have an impact on the way in which decisions that would concern them are made.

The baseline profile included in the EIA for the Trekkopje Mine indicated that there was a large shortage of housing in the Arandis area, where up to 150 people were placed on a waiting list. This number has since increased to approximately 260 [6] people on the waiting list for housing. Existing households all have access to sufficient municipal services such as water, electricity, sanitation and refuse removal.

6.3.5 Socio-cultural processes

Socio-cultural processes relate to the way in which humans behave, interact and relate to each other and their environment, as well as the belief and value systems which guide these interactions.

At this time not enough information is available to determine the level of cultural and place attachment that residents have to the area. However, in terms of socio-cultural processes it should be noted that sense of place goes hand in hand with place attachment, which is the sense of connectedness a person/community feels towards certain places. Place attachment may be evident at different geographic levels, i.e. site specific (e.g. a house, burial site, or where religious gatherings take place), area specific (e.g. a residential area), and/or physiographic specific (e.g. an attachment to the look and feel of an area). The concept of sense of place therefore attempts to integrate the character of a particular setting with the personal emotions, memories and cultural activities associated with such a setting.

[6] ***CEO Arandis Town Council (Personal communication June 2009)***

6.4 Synopsis of Findings

6.4.1 Environmental

Cultural Heritage and Archaeological

A detailed assessment of the potential impact of the road project will be undertaken. The field survey entails a full examination of the route and surrounding area with a detailed documentary and photographic record of all archaeological occurrences. The sampling density of the field survey is be determined by the desk assessment. Actual observations (from the field survey) and inferred occurrences (based on the aerial photography) will be integrated within a GIS project framework (ArcView), with all field survey records in digital format (MS Access).

Archaeological sites will be assessed according to their significance and their vulnerability to impacts. Significance is estimated using a scale of 0 – 5, according to the value of a particular site or object to the cultural history of the area and the surrounding region. The significance rating is also affected by the state of preservation and the degree of previous impact. Vulnerability is estimated on a parallel scale of 0 – 5, according to the exposure of the site or object to future impact. The two scales allow value and risk to be independently assessed.

Biodiversity - Fauna and Flora

A detailed assessment of the potential impact on the ecology of the route and surrounding area will be conducted. This will include a baseline assessment to list all species present within the area affected by the road. All rare and endangered species, all protected species recorded, all endemic species, all invader and/or exotic species and species that can potentially occur will be identified. The baseline will be constructed through desktop studies, field surveys and vegetation classification. The management plan will provide guidance on avoidance of key species. Where these cannot be avoided, procedures for rescue and replanting will be provided.

Noise

A detailed assessment of the potential noise impact on the town of Arandis and surrounding area will be conducted. The pre-development ambient noise levels will be estimated by sampling noise measurements at representative locations and at representative times during the day and night. The measurements will be taken in accordance with the procedures stipulated in SANS 10103:2008 ‘The measurement and rating of environmental noise with respect to annoyance and to speech communication’.

A detailed model will be developed for noise emissions from the access road, based on the procedures described in SANS 10357:2004 'The calculation of sound propagation will be undertaken using the Concawe method'. This model will take account of the topography of the area as well as climatic, diurnal and other conditions that influence the propagation of noise between source and receiver.

The noise impacts will be expressed as contours of the estimated increase in ambient noise levels, and the resulting ambient noise levels due to the noise emissions from the mining operation. The contours will be superimposed on a scaled map of the area.

The noise impacts will be assessed in terms of the guidelines provided by the World Health Organisation, the World Bank, the International Finance Corporation, and SANS 10103:2008. If the noise impacts are significant, then effective mitigation measures will be calculated and illustrated.

A detailed report will provide a description of the methodology, findings and recommendations of the noise impact study.

6.4.2 Social

The impact variables were categorised in terms of change processes. A change process can be defined as change that takes place within the receiving environment as a result of a direct or indirect intervention. A potential impact follows as a result of the change process. However, a change process can only result in an impact once it is experienced as such by an individual/community on a physical and/or cognitive level. The categories of processes are as follows:

- *Demographic processes:* the number and composition of people;
- *Geographical processes:* land use patterns;
- **Economic processes:** the way in which people make a living and the economic activities in society;
- *Empowerment and institutional processes:* the ability of people to be involved and influence decision making processes; and the role, efficiency and operation of governments and other organisations; and
- *Socio-cultural processes:* The way, in which humans behave, interact and relate to each other and their environment and the belief and value systems which guide these interactions.

Demographic Change Processes

The construction and maintenance of the proposed access road could lead to a change in the number and composition of the population within the affected local area, which in turn could lead to economic, land use, and socio-cultural change processes. However, it is believed that the demographic change processes brought about by the actual construction of the access road would be temporary in nature, except maybe in instances where job seekers enter the area and then remain in the area in hope of securing a permanent position.

Plan of study for the EIA Phase:

- Conduct a desktop study to determine what the expected population growth rate is and how this would be influenced by factors such as HIV and TB infection rates in order to establish how the population would have expanded without the influx of construction workers and/or job seekers;
- Obtain information from the project proponent and/or their appointed contractor on the size of the construction team and where labour would be sourced from; and
- Obtain and analyse information from the public participation consultants on the local residents' expectations in terms of the proposed project within the social realm, in order to better understand local residents' viewpoint on the proposed project and the potential risk for conflict and other forms of active and passive social mobilisation.

Geographical Change Processes

Geographical change processes refer to land use change as a result of the actual or perceived changes in land use, whether it be on a temporary or permanent basis. The proposed access road might lead to a change in the land use within the local area. The assessment of a land use change process from a social perspective takes into account how the proposed road might affect the behaviour/lives of land owners and/or land users.

Plan of study for the EIA Phase:

- Obtain landowner information from the public participation consultant;
- Discussions with the relevant municipal official(s) in Arandis to determine future land use developments and how the road might impact on such developments (be it negative or positive);
- Determine the land use in the area by conducting a site visit. During this site visit, conduct informal discussions with residents to determine if and how a change in land use could affect the livelihoods of people in the area;
- Obtain information from the project proponent on how the road would be rehabilitated upon mine closure; and

- Obtain information from the public participation consultants on possible land claims in the area.

Economic Change Processes

Economic change processes relate to the changes brought about to the employment and general economic profile of an area as a result of the introduction of any development. For example, job opportunities might be created as a result of the construction and maintenance of the proposed access road. Employment creates a source of income, which in turn enables the employed individual to access services and a support mechanism for his/her family.

Plan of study for the EIA Phase:

- Obtain information from the project proponent on the number of employment opportunities that would be created through the construction and maintenance/operation of the access road and how many of these opportunities (and at what levels) would be afforded to local residents; and
- Obtain and analyse information from the project proponent on an average salary package for the various levels of labour/employment to determine the extent and timeframe of economic impacts on local residents as a result of employment.

Institutional and Empowerment Change Processes

Institutional and empowerment change processes relate to the way in which the proposed project might change the face of service delivery in the area and how this change might affect the quality of life of local residents. It furthermore assesses local resident's ability to negotiate such changes in a way that is mutually beneficial to both the project proponent as well as the affected landowners.

Plan of study for the EIA Phase:

- Analyse the issues register / issues report from the public participation process to determine the recurrent issues raised by the public and how these issues were addressed throughout the process. This analysis will indicate the risk of social mobilisation;
- Interview the relevant municipal official(s) to determine the local municipality's ability to sustain additional connections to the municipal services infrastructure; and
- Obtain and analyse information on the size, composition and infrastructure of a construction village.

Socio-cultural Change Processes

Socio-cultural change processes that are associated with the construction and operation of the proposed project include changes such as health and safety aspects and sense of place. The concept of 'health' is not only limited to physical health (i.e. the absence of ailments or illness), but also includes mental and social health. The expected changes that can occur in relation to health and safety aspects can be as a result of the presence of the proposed access road (motor vehicle accidents), as well as the presence of construction workers and/or job seekers during construction.

Plan of study for the EIA Phase:

- Obtain information from the public participation process on the surrounding landowners. Either attend or organise a focus group meeting with these landowners or a landowner representative body such as a residents association to determine their attachment to the area;
- Obtain information from the project proponent or appointed contractor on the safety measures implemented at a construction site of this nature, for the safety of both the construction workers as well as that of the surrounding residents;
- Obtain crime statistics for the town of Arandis from the local police service; and
- Conduct an observational study to determine the daily movement patterns of local residents. Where possible, have informal discussions with local residents to determine their place attachment and social and cultural practices.

7 CONSIDERATION OF ALTERNATIVES

7.1 Objective of Identifying Alternatives

International best practise requires that alternatives to a proposed activity be considered. Alternatives are different means of meeting the general purpose and need of a proposed activity. Alternatives may include location or site alternatives, activity alternatives, process or technology alternatives, temporal alternatives or the no-go alternative. (The no-go alternative is the option of not undertaking the proposed activity or any of its alternatives. The no-go alternative also provides the baseline against which the impacts of other alternatives should be compared).

The identification, description, evaluation and comparison of alternatives are important for ensuring the objectivity of the assessment process. In cases where there is no objective and thorough assessment of alternatives, the EIA process usually only confirms a chosen activity and the value of the assessments as an input to decision-making may be compromised.

The primary objective of the alternatives assessment for the various road routes is to provide a means of selecting the most suitable access route from three alternatives by weighing the relative environmental, social, technical and economic costs and benefits of each.

7.2 The Assessment of Alternatives

The assessment of alternatives should follow the impact assessment process and should, as a minimum, include the following:

- the consideration of the no-go alternative as a baseline scenario (even in cases where the no-go alternative is not a realistic alternative);
- a comparison of the selected alternatives; and
- the providing of reasons for the elimination of an alternative

Where alternative locations or sites are identified as alternatives, the features of each location or site should be investigated to the same level of detail for the purposes of the comparative assessment of the alternatives. The comparative assessment should at least include the following aspects:

- capital and operating costs;
- direct, indirect and cumulative impacts;
- mitigation measures;
- physical, legal or institutional constraints; and
- compliance with policy and legal requirements

7.3 Selection of project alternatives - objective

The main objective of this study is to conduct a robust alternatives assessment and trade-off study using a multiple accounts analysis methodology to determine the most appropriate route taking into consideration environmental, social, economic and technical aspects.

This alternatives assessment provides project-wide screening to qualitatively and quantitatively assess the environmental and social risks. This was achieved through:

- identifying information gaps in the knowledge base required for selection of alternatives,
- evaluating the three possible access routes identified (see below for details of the routes),
- establishing a ranked preference list of access alternatives based on the relative costs and benefits of each and
- providing decision makers with an informative tool for the selection of the highest benefit/lowest cost access route

7.4 Multiple Accounts Analysis

A detailed Multiple Accounts Analysis was undertaken by the project team during the scoping phase of the project. The full results of the analysis and description each alternative are presented in APPENDIX I.

The Multiple Accounts Analysis (MAA) methodology is based on four main accounts; namely, environmental, technical, social and project economics. These main accounts are broken down into a list of sub-accounts followed by a of list indicators which determine the parameters on which the assessments are made. The sub-accounts can be defined as the broader issue on which the resulting impact (benefit or loss) has a material influence on the alternatives being evaluated.

A scaled value (S) is assigned to each indicator alternative using a nine-point scale. The nine-point scale provides for a degree of differentiation between alternatives and the “best” alternative in the ranking is always given a high value from 7 to 9. If the “worst” alternative is considered half as good as the best, it is given a value of 5 and the other alternatives are distributed between these values.

Each indicator, sub-account, and account is then assigned a weighting factor (W) according to its relevant importance with respect to the other accounts, sub-accounts or indicators within the same level. A weight of 5 indicates a “high value” and 1 a low value. The methodology and determination of weighting factors used for environmental and social impacts is described in detail in APPENDIX III.

7.5 Brief description of Alternatives

7.5.1 The No-go option

Trekkopje Mine currently uses the existing gravel road that links the Annaberg Tin Mines to the B 2. This road has been used for prospecting activities, construction of the mine infrastructure; start up mining, and for tourist access to the historical Tin mines. The company Uramin who undertook the initial prospecting and trial mining of the Trekkopje orebody were committed through the undertakings of the approved environmental management plan to upgrade the existing route to a bitumen surfaced road. The distance from Trekkopje siding to the mine is 40 kilometres. The road is currently maintained by Areva through regular grading and is passable for general traffic including trucks and buses. For the purposes of the trade-off study and alternatives assessment the no-go option is listed as Alternative 1.

7.5.2 Description of Alternative 2 – Temporary Pipeline Route

A temporary water pipeline was established from Arandis to Trekkopje mine in order to supply the initial requirements of the mine. A service track was established adjacent to the pipeline for routine maintenance checking. The pipeline route is 30 kilometres long and was established in a straight a line as possible crossing directly over numerous ridges and washes. The road is not regularly maintained and is not passable for regular traffic other than 4 x 4 vehicles.

7.5.3 Description of Alternative 3 – Quarry Road

The quarry road was established to provide access from Arandis to the stone quarry owned by Dr. Green. The road is not passable for general traffic and is not maintained. This road passes through numerous sensitive areas including deep washes and many braided flood plains with high biodiversity.

7.6 Preferred alternative

The multiple accounts analysis methodology provides for the alternative with the highest score is the preferred and best option. The detailed assessment of the three proposed alternatives resulted in Alternative 2, the temporary pipeline route from Arandis to Trekkopje Mine emerging as the best option taking into account environmental, social, economic and technical aspects of the project. The table below provides a summary of the results.

TABLE 7.1 – SUMMARY OF FINAL ACCOUNTS									
	Alternative 1 Current Road			**Alternative 2 Pipeline Route**			**Alternative 3 Quarry Road**		
Sub Accounts	Sub account merit rating	Weight (W)	Score	Sub account merit rating	Weight (W)	Score	Sub account merit rating	Weight (W)	Score
Environmental	4.87	5	24.34	5.43	5	**27.16**	4.00	5	20.00
Technical	5.07	2	10.14	5.82	2	**11.63**	4.53	2	9.07
Social	6.03	4	**24.11**	4.88	4	19.54	4.20	4	16.79
Project Economics	3.46	5	17.28	6.45	5	**32.24**	5.50	5	27.50
		Merit score	75.86			90.58			73.36
		Merit rating	4.74			**5.66**			4.59

Alternative 2 – the Pipeline Route received the highest score and merit rating and therefore is the preferred overall route, followed by Alternative 1 – the current road, and the least preferred option is Alternative 3 – the quarry road. Alternative 3 – The Quarry Road was therefore dropped as an option.

The following table provides a description of the most important considerations with regard to Alternatives 1 and 2.

TABLE 7.2 – SYNOPSIS OF ALTERNATIVE CONSIDERATIONS	
Preferred Alternative – Temporary Pipeline	**Current Access Road**
Currently a disturbed corridor with an on-surface pipeline and service track. Recommendation is to remove the road and rehabilitate the corridor on mine closure.	Is the current mine access road and permanent disturbance corridor. The road will remain a permanent fixture to the Annaberg Tin Mine for tourism purposes. The road will need continuous maintenance.
Borrow pits	
Will require approximately 630 000 m^3 of fill material.	Will require approximately 847 000 m^3 of fill material.
Water & Power supply	
Water for construction will be sourced from the temporary pipeline. Power for operation of equipment at the rail / road terminal will be provided from Arandis.	Water for construction will need to be trucked onto site via water cart from either the mine or Arandis with associated transport emission factors and dust. A powerline with associated capital cost and impact corridor will need to be constructed to provide power at Trekkopje siding. A water pipeline with associated capital cost and

Water required for the terminal will be provided from Arandis.	impact corridor will need to be constructed from Arandis to provide water.
Infrastructure - housing	
Site supervisory staff will be housed in Arandis. Closure of mine: Personnel will remain in Arandis	Site supervisory staff may be housed in Arandis and transported to Trekkopje siding or alternatively houses will need to be constructed at the siding. No facilities are currently present to accommodate people. Closure of mine: The houses will remain but will possibly become redundant.
Sewage	
Will be provided as part of Arandis infrastructure expansion	No sewage currently on-site. French drains will need to be constructed.
Rail / road terminal infrastructure	
Rail / road terminal will form part of Arandis industrial expansion. On closure of Trekkopje Mine, Arandis Town Council will be able to utilise the infrastructure or lease to other mines in the area.	Road / rail terminal will need to be removed as no post closure use will be possible or should it remain will become redundant.
Safety	
Mine traffic interaction with the general public will be limited to the B 2 from Swakopmund to Arandis – 57.5 km	Mine traffic will interact with the general public for 76.3 km. The road from Arandis to Trekkopje is marginally narrower increasing the risk of accidents. In addition traffic will interact with mine vehicles up to the Annaberg Tin mine site.
Construction camp	
Construction staff can be employed from Arandis and therefore no or very little accommodation needs to be provided. A site office can form part of the road / rail terminal.	A residential camp and site office will be necessary for construction purposes with the required water, power, and sewage and refuse disposal facilities.
Post mine closure use	
Infrastructure will form part of Arandis town industrial expansion and with the possibility of lease to other mining or auxiliary business operations.	At this – no post closure use will be possible. Either the infrastructure will be removed as part of closure commitments or will remain redundant for possible future unknown use.
Fauna & flora disturbance	
Width of one road including shoulder - 11 meters 3 meters either side as a buffer – total width 14 meters.	A larger impact corridor will be created due to the additional length of road area loss to borrow pits. The loss of habitat and interaction with fauna is larger. Included in the loss will be the impact of associated infrastructure such as powerlines and water supply to Trekkopje siding.
Carbon footprint	
Based on the vehicular data for the month of July 2009 the total CO^2 that would have been emmitted on this road is **81.2 tons**	The total CO^2 emmitted on the current access road for the month of July 2009 is **157.3 tons**

Taking into account the numerous factors and associated impacts related to the project the preferred alternative is to construct the access road following the temporary pipeline route. Chapter 8 details the predicted environmental impacts related to the construction of the road.

8 ENVIRONMENTAL IMPACT ASSESSMENT

8.1 An Evaluation of the Overall Effect on the Total Ecosystem and Surroundings

Road construction and operation through ecologically sensitive areas has the potential to negatively affect the surrounding ecosystem.

The most significant impacts on the biophysical and socio-economic environments include the following:

- dust dispersion as a result of construction activities
- residual impacts potentially arising from borrow pits and un-rehabilitated surfaces on closure
- direct loss of habitat and animal species as a result of the road infrastructure and additional road kill due to vehicle movement
- disruption of established surface water channels
- continued fragmentation of the desert habitat
- expansion of the local, regional and national economies through economic multipliers (procurement, services, salaries, taxes, royalties)
- increased employment through the creation of jobs
- potential disruption of the existing social order

A summary table presented below (See TABLE 8.1.) provides a high level overview of the project's interaction with environmental components. TABLE 8.1 assesses the receiving environment of the project by posing a series of questions on the environment and the potential impacts.

The colours in TABLE 8.1 represent the potential degree of risk associated with the project in this particular environmental and regulatory setting. Green indicates low levels of potential risk, yellow and amber indicate an intermediate level of potential risk and red indicates high levels of potential risk.

TABLE 8.1 – KEY ELEMENTS FOR ANALYSIS[7]

Character of the receiving environment	*Potential impacts of proposal*	*Resilience of natural and human environments*	*Confidence of prediction of impacts*	*Planning, policy framework/ statutory decision-making processes*	*Degree of public interest*
Is it, or is it likely to be, part of a conservation area? ***The site is located***	Will construction, operation and/or decommissioning of the proposed project have	Can the receiving environment absorb the level of impact predicted	What level of knowledge do we have on the resilience of a	Is the proposal consistent with the existing zoning or the long-term policy	Is the proposal controversial or could it lead to controversy

[7] ***Modified after Thomas & Elliot, 2005***

in the #Gaingu Conservancy and is close to the boundary of the WCRA.	potential to cause significant changes in the receiving environment? ***Construction, operation and decommissioning/ closure of the project have the potential to cause significant changes in the environment.***	without suffering irreversible change? ***The receiving environment is not likely to absorb the level of impact predicted without suffering irreversible change. Mitigation measures are required.***	given significant ecosystem? ***The ecosystems of the Central Namib are well understood, but their resilience and potential for recovery after road construction is not.***	framework for the area? ***Existing zoning or long-term policy framework for the area is unclear. Current adjoining land uses include uranium mining and ecotourism***	or concern in the community? ***Yes, the possibility exists.***
Is it an existing or potential environmentally significant area? ***The site is located on gravel plains of the Central Namib – an ecologically important, but extensive area.***	Could the implementation of the proposal give rise to health impacts or unsafe conditions? ***The health and safety issues associated with the project are manageable.***	Can land uses at and around the site be sustained? ***Potential land uses at and around the road may potentially change but may be sustainable with careful management and additional resources.***	Is the project design and technology sufficiently detailed and understood to enable the impacts to be established? ***The project design is at feasibility level, allowing impacts to be established.***	Do other statutory approval processes exist to adequately assess and manage project impacts? ***Yes.***	Will the amenity, values or lifestyle of the community be adversely affected? ***This is unlikely to be significant.***
Is it vulnerable to major natural or induced hazards? ***The gravel plains are sensitive to erosion, dust generation and loss of species. High wind conditions can be expected. Extreme rainfall events result in flash floods.***	Will the project significantly divert resources to the detriment of other natural and human communities? ***The project has a low probability of diverting resources to the detriment of other natural and human communities.***	Are contingency or emergency plans proposed or in place to deal with accidents? ***Contingency plans and emergency plans are to be drawn up as part of the detailed design.***	Is the level and nature of change in the natural/human environment sufficiently understood to allow the impact of the project to be predicted and managed? ***Yes.***	What legislation, standard codes or guidelines are available to properly monitor and control operations on site and the type or quality of the impacts? ***The project is subject the minerals, environmental and water legislation of Namibia as well as the Equator Principles and IFC performance standards.***	Will the proposal result in inequities between sectors of the community? ***Such impacts will be limited.***
Is it a special purpose area? ***The road site is not located in a special use area.***			Is it practical to monitor predicted effects? ***Yes***		

Key: green = very low risk; yellow = potentially low risk; amber = potentially high impact; red = potentially significant risk.

8.2 Criteria Used in the Evaluation

As introduced in Chapter 4 and APPENDIX I and II, impacts can be ranked according to their significance. Elements which contribute towards significance include the following:

- social, ecological and aesthetic significance of the identified factors
- prioritising of issues raised by the public
- legal requirements, standards and guidelines that need to be met
- ranking of predicted impacts in order of priority for avoidance, mitigation, compensation (where applicable) and monitoring
  (Sadar, 1994, in Thomas & Elliot, 2005)

The main elements for assessing significance of an impact are the level of public concern, scientific and professional judgement, the extent of the disturbance to ecosystems and the degree of impact.

Best practice requires that an impact assessment must:

- link impacts to project components
- describe how a particular element of the project may give rise to the impact
- describe the probability of the impact occurring and
- describe the magnitude of the impact and its extent over space and time
  (Thomas & Elliot, 2005)

8.2.1 Social

Social significance can be determined by considering:

- effects on human health and safety
- potential loss of species or resources (including land) with current or potential value
- recreational/aesthetic value
- demands on public resources and services
- demands on public infrastructure
- demographic effects
- creation of livelihoods
- support of social services
- stimulation of development in general

8.2.2 Ecological

Ecological significance can be determined by considering:

- effects on plants and animal behaviour
- presence of rare and endangered species
- ecosystem resilience, sensitivity, biodiversity and carrying capacity
- variability of local species populations

8.3 Evaluation of Water Impacts

The route of the proposed access road proceeds NNW towards the mine tenement from Arandis (see FIGURE 8.1). It crosses uneven terrain of ranges of low hills, rocky ridges and numerous washes. The rocky ridges and washes are at right angles to the route, which is consequently very undulating. Between Arandis and the southern boundary of the Trekkopje tenement the route traverses a series of prominent schist, dolerite and marble ridges. Within the tenement, the route follows a network of existing tracks across a wide gravel plain with well developed drainage lines. The terrain along the route is relatively undisturbed by tracks and other impacts, except within the tenement and near Arandis. The area traversed by the proposed access route can be provisionally subdivided into two zones which separate at S 22°18'54"; E 14°57'17". The southerly zone is rocky with numerous marble and dolerite ridges and the northerly zone comprises open plains with numerous drainage lines and only occasional rocky outcrops.

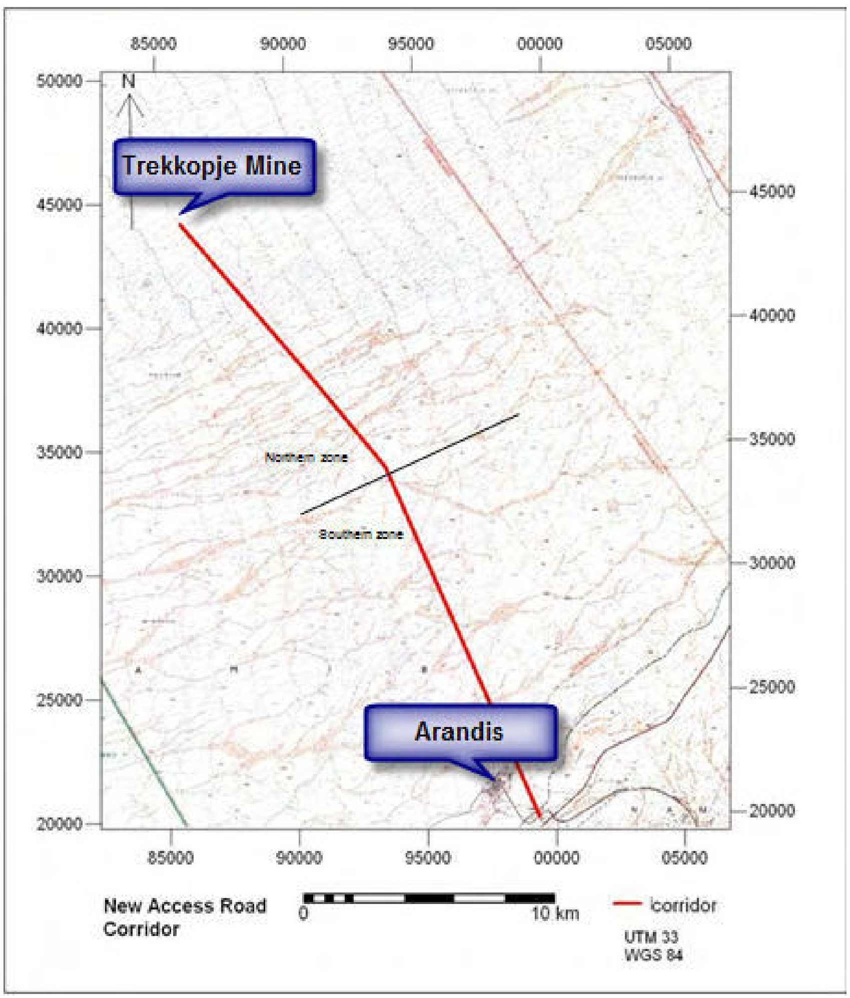


FIGURE 8.1 – PROPOSED CORRIDOR FOR THE NEW ACCESS ROAD.

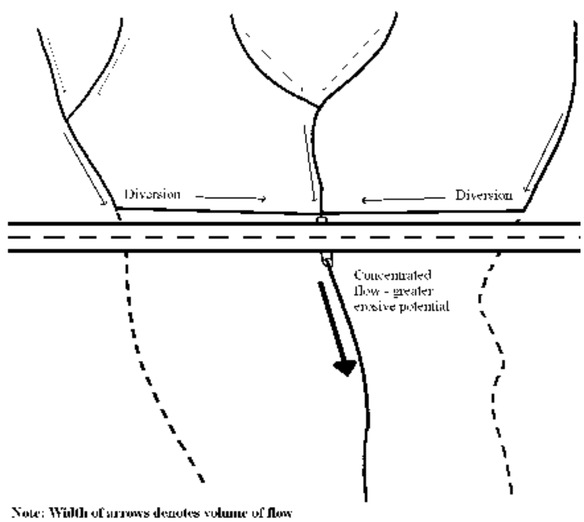
8.3.1 Description of impacts

It is inevitable that road developments intersect drainage basins. Where this intersection occurs, the alteration of local hydrology is inevitable. Road development can lead to three types of modification to the natural hydrological environment.

Direct Impacts

- Modification of surface flow.
- Water quality degradation.

<u>*Surface water flow modification*</u>: Roads intersecting drainage basins alter the natural flow of surface water by concentrating flows at certain points which results in increasing the speed of flow, as illustrated in FIGURE 8.2. Depending on local conditions, these changes can contribute to flooding, soil erosion, channel modification, and siltation of watercourses. These effects are often felt well beyond the immediate vicinity of the road. The proposed road to Trekkopje Mine intersects numerous washes and drainage lines therefore increasing the incidence of this potential impact.



Source: World Bank – Roads and the Environment: A Handbook

FIGURE 8.2 – CONCENTRATION OF SURFACE WATER FLOW

<u>*Water quality degradation (surface & ground water)*</u>: Sedimentation, changes in biological activity in watercourses and on their banks, uncontrolled construction activities, and spills of chemicals and pollutants can all have adverse effects on road-side water quality. Chronic pollution of surface runoff from exhaust emissions,

pavement and tire wear, hydrocarbon drippage, and corrosion of metals add to potential impacts.

Indirect impacts

- Groundwater flow modifications

<u>*Ground water flow modification*</u>: Road drainage and excavation can lower the water table in surrounding areas, while embankments and structures can raise the water table by restricting flow. The potential effects include deterioration of vegetation, increased susceptibility to erosion, and habitat changes for wildlife. Figure 8.3 provides an illustration of potential groundwater modification due to road construction.

Cumulative impacts

In the context of the proposed Trekkopje road, potential cumulative impacts could arise through damage to local vegetation and concentration of stream flow through channelling resulting in erosion and downstream siltation of washes and watercourses. Regional cumulative impacts could potentially occur through continuous construction of roads to mining sites resulting in widespread impacts.
Source: *World Bank – Roads and the Environment: A Handbook*
FIGURE 8.3 graphically depicts cumulative impacts related to water.

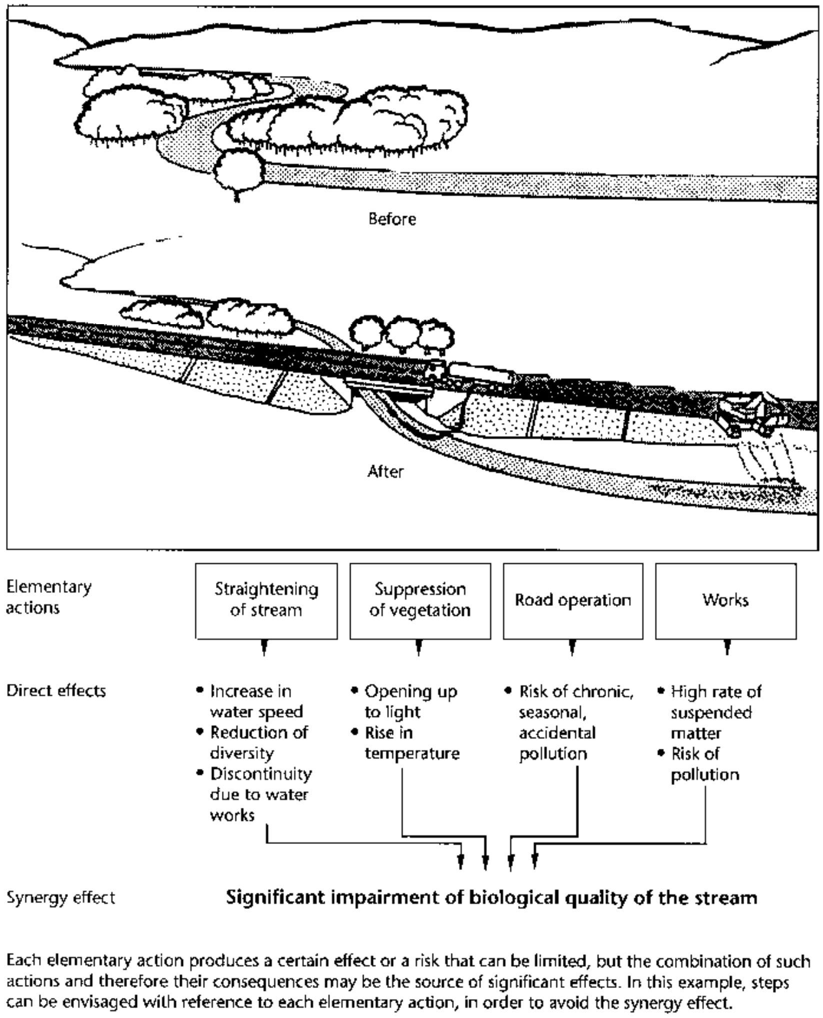


FIGURE 8.3 – WATER RELATED CUMULATIVE IMPACTS

8.3.2 Impact assessment

The most important water related impacts associated with the road will be surface destruction through construction activities and the channelling of the many dry riverbeds and washes. The proposed route diagonally crosses numerous drainage washes and small dry watercourses.

Summary of mitigation measures

The most important mitigation measure will be:

- Placement of an adequate number of drainage culverts so as to avoid channelling of streams.

- Concrete and natural stone dissipation structures designed to slow fast-running storm water thereby reducing its downstream erosive potential.

Even though rainfall incidents in the Namib Desert are infrequent, the potential impact of erosion and sedimentary run-off will be permanent to long term.

The greatest surface disturbance impact will be the creation of borrow pits for fill material. The single most important mitigation measure would be as far as possible to avoid the construction of borrow pits in washes and drainage lines as these are areas of high endemic plant and animal life and will be the catalyst for erosion and sedimentary run-off. However road construction of this nature requires large volumes of “borrow” material and therefore the creation of borrow pits is unavoidable. In the Trekkopje / Arandis area the most suitable material to be used as fill is located in the washes and drainage channels.

Predicted impacts with no mitigation measures:

- *Nature of the impact:* Assesses the effect the activity would have on the environment. The impact of the road on water quality and drainage will be negative.
- *Intensity:* The unmitigated impact is expected to be high, where the present natural processes will be altered to the extent that they temporarily or permanently cease. This will result in a deterioration of the impacted environment.
- *Extent:* The geographical extent of the impact will be local and primarily to the Swakopmund / Arandis / Trekkopje area.
- *Duration:* The lifetime of the unmitigated impact will be permanent. The impact of erosion and sediment on the receiving environment will effectively be irreversible and will extend well beyond the life of mine.
- *Potential for mitigation/optimization:* Is low; the potential for the receiving desert environment to recover on its own is limited because of a lack of capacity/resources and coping mechanisms. The rate of recovery in desert environments is extremely slow.
- *Probability:* The likelihood of the unmitigated impact occurring is highly probable as rainfall events even though intermittent in the desert environment, will occur with the resultant erosion and sedimentation impacts.
- *Significance:* High – where for negative impacts the decision to proceed with the project should be with stringent mitigation measures. Mitigation measures are provided for in the EMP.

- *Frequency of occurrence:* The unmitigated impacts related to channelling of waterways and washes will be continuous in nature as and when rainfall events occur.
- *Phase:* All phases - impacts are assessed for their occurrence at particular phases of the project life-cycle and without mitigation these will occur during all project phases from construction to post closure.
- *Degree of confidence in predictions:* Certain – a statement of the degree of confidence in the predictions is based on the availability of information and the specialist's knowledge and expertise. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.

Predicted water quality & drainage impacts with mitigation measures in place

- *Nature of the impact:* The mitigated impact through the placement of adequate number of culverts and no re-channelling of drainage donga's and washes will be neutral.
- *Intensity:* The mitigated impacts are expected to be low. The impacts should have no effect on the natural, cultural and social functions and processes beyond that of nuisance value.
- *Extent:* The geographical extent of the impact will remain local to the Swakopmund / Arandis / Trekkopje area.
- *Duration:* The lifetime of the mitigated impact is expected be medium term where the impact will coincide with the operational life of the project and the effective rehabilitation of the disturbance corridor.
- *Potential for mitigation/optimization:* Medium – through the implementation of effective mitigation measures the receiving desert environment should be able recover on its own.
- *Probability:* Where culverts are placed at each and every wash and drainage channel along the route the possibility of the impact materialising is low to unlikely. However where a limited amount of channelling occurs due to design constraints there is a distinct possibility that an impact will occur.
- *Significance:* Is determined as moderate– this impact will not be avoided unless mitigation measures are put in place and could require modification of the project design.
- *Frequency of occurrence:* The mitigated impacts related to channelling of waterways and washes will be continuous in nature as and when rainfall events occur.
- *Phase:* All phases.
- *Degree of confidence in predictions:* Certain – A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.

Summary

Through effective design and alignment of the road and with the placement of adequate culverts the impacts related to the water regime can be mitigated. Adequate culverts will also allow for the continuous movement of fauna (and flora through streamflow activity) to continue relatively undisturbed.

8.4 Evaluation of Flora & Fauna Impacts

Desert ecosystems are characterized by extreme temperature fluctuations, low annual rainfall, and high evaporation. As a result, their species diversity tends to be low (also endemic) and vegetation is usually sparse. What rainfall they do receive is often in brief but very intense episodes; these events have tremendous erosive potential given that the soils are generally sparsely covered and low in organic matter. For climatic reasons, recovery or re-colonization of damaged areas tend to be slow.

The issue of impacts on flora and fauna is much broader than a concern for individual specimens, and therefore the broader area must be considered in the context of biodiversity conservation. Biodiversity refers to the wealth of species and ecosystems in a given area and of genetic information within populations. It is of great importance at global and local levels.

At the ecosystem level, biodiversity provides flexibility for adaptation to changing conditions, such as those induced by human activity. Preservation of biodiversity is of global concern, but the causes of loss and their solutions are very often local in scale. Road development continues to be a major player in the overall reduction of biodiversity, and proper planning at the project level can go a long way in limiting the loss, while still serving the transport need.

The ecological function of a habitat type relates to the inherent resistance or resilience of that system. This is a measure of the degree of disturbance that a system can tolerate. Generally, three categories are used to describe ecological function (sensitivity):

- High – sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors, or highly dynamic systems, the stability of which is considered important for the maintenance of ecosystem integrity. Most of these systems represent late successional ecosystems with high connectivity with other important ecological systems,
- Medium – these systems occur at disturbances of low-medium intensity and representative of secondary successional stages, with some degree of connectivity with other ecological systems and
- Low – degraded and highly disturbed systems with little ecological function.

The Trekkopje area's sensitivity is rated medium to high due to the presence of Lichens and the possibility of undescribed species.

Ecological conservation importance is indicated by species diversity, endemism (unique species) and the presence of threatened/protected species or ecosystems protected by legislation. As a rough guideline, three categories are used to describe conservation importance:

- High – Ecosystems, with high species diversity, that usually provide suitable habitat for a number of threatened or rare species. These areas should be protected;
- Medium – Ecosystems with intermediate levels of species diversity without any threatened species; and
- Low – Areas with little or no conservation potential and usually species poor (weeds and invasive alien species may be abundant).

The Trekkopje area is considered to be of high conservation importance due to the ecosystem sensitivity and habitat specific genetic adaptation.

8.4.1 Impact assessment

The impacts associated with fauna and flora have been summarised into direct and indirect impacts related to all the phases of the project.

Summary of mitigation measures

- Locate route on less sensitive sites.
- Possible use of suitable mine overburden material for road fills (needs to be confirmed).
- Road should not be fenced.
- Avoid off-road driving.
- Move top soil only when it is unavoidable.
- Strictly limit clearance to required dimensions.
- Operate during daylight hours and avoid night use as far as possible.
- Use dust suppression during construction.
- Use removed soil to cover borrow pits after use.
- Set speed limits.
- Provide appropriate signage.
- Set emergency plan to deal with leakages of hazardous substances.

Direct Impacts

Habitat loss: The consumption of land, and the consequent loss of natural habitat, is inherent in road development. Where new roads intersect habitat, the area occupied by the road itself, borrow pits, and quarries is subtracted from the total habitat area available to flora and fauna.

Habitat fragmentation: When a road cuts through an ecosystem, the sum of the two parts created by the cut is less than the value of the initial whole, even when the habitat loss is ignored. Ecosystems are characterized by complex, interdependent relations between component species and their physical environment, and the integrity of the ecosystem relies on the maintenance of those interactions. By slicing through habitat, roads affect an ecosystem's stability and health. Roads tend to fragment an area into weaker ecological sub-units, thus making the whole more vulnerable to invasions and degradation. Nevertheless, roads and natural ecosystems can co-exist if the relationship is built on careful planning.

Of significant importance for the Trekkopje project is that the current access road was assessed as an alternative as it has historical impacts embedded in the ecosystem. The new road will create an additional corridor and further fragment the area. Therefore the recommendation is to remove the new road on mine closure in order to restore the fragmented habitat.

Corridor restrictions: Most animal species tend to follow established patterns in their daily and seasonal movements. The areas, through which they move to and from feeding, breeding and birthing grounds, and between seasonal ranges, are known as corridors. When a road intersects or blocks a corridor, the result is either cessation of use of the corridor because animals may become reluctant to cross the road, an increase in mortality because of collisions with vehicles, or a delay in migration which may result in the weakening or disappearance of an entire generation of the population. Unfortunately, some animals are attracted to roads for various reasons, including protection from predators, good food supplies, and better travel conditions. This often leads to accidental death and poaching. On busy roads, the death rate for slow-moving animal populations can be high.

Erosion - habitat damage: Road development has perhaps its most serious effects on aquatic ecosystems. Erosion from poorly constructed and rehabilitated sites can lead to downstream siltation.

Rechanneling of waterways is often undertaken as part of road construction to avoid flooding and make crossing structures simpler. Cost consideration due to the number of required culverts often determines how many drainage channels are merged resulting in the alteration of natural streambeds. Frequently, the result is a straight, featureless channel, which may be an efficient evacuator of water, but has little in the way of natural eddies, shaded areas, and sheltering ledges, and increases the speed of the water which increases the incidence of erosion. This in turn increases the amount of sediment in the water resulting in downstream siltation. Careful planning and construction of culverts where they cross over washes needs to be undertaken in order avoid this impact. Numerous washes and drainage

channels will be crossed by the new access road and potential for sedimentation as a consequence of erosion is high.
Interruption of biogeochemical cycle: The flow of nutrients and materials is a major determinant in ecosystem structure and function, and road development can easily disrupt it through alteration of flows of surface and groundwater, removal of biomass, and relocation of topsoil. The soils of the Trekkopje area are highly erodible once the soil crust is disturbed.

Indirect impacts

In many cases, indirect impacts are more damaging than direct ones, and their effects can be felt farther, sometimes several dozen kilometres, from the road.

Accessibility: Roads increase contact between humans and the natural environment, which in most cases leads to ecosystem modification. Penetration of previously unmodified areas makes them available for a host of human activities of varying effect, from recreation, mineral exploitation and poaching. In the Trekkopje context the road will be private and not for public use.
Ecological disequilibrium: The importation of new plant and animal species along the right-of-way can upset the dynamic balance which exists in ecosystems. Native species face competition for resources from new arrivals, and predator-prey relationships can be altered, often to the detriment of the native species. Non-native species can gain a competitive advantage because of a lack of natural controls and become dominant. The result is usually a simplified ecosystem which is more vulnerable to further impacts. In some cases, road development may actually alter the ecological equilibrium in a positive way by providing for the creation of new ecotones, which tend to be relatively biodiverse. This will only apply if the total area of the existing system is relatively large compared to the newly created ecotone. Also, the potentially positive effect will often be negated by the impacts discussed above.
Contamination of the biota: The presence of motor vehicles introduces the potential for contamination of the soil, air, and water adjacent to the road and in the case of surface water, well beyond the immediate surroundings.
Fires: Increases in human activity are often associated with more frequent incidents of fires, which can obviously have sudden, severe, and wide-ranging impacts. The Trekkopje area has sparse vegetation with extremely low risk of fire.
Transmission of disease: Roads are effective vectors for the spread of diseases, which can have marked impacts on populations of plant and animal species. Carriers of diseases, both floral and faunal, can gain easy access to wilderness areas along new road corridors.

Cumulative impacts

The Erongo region is experiencing large tracts of land and greater numbers of natural sites being converted for mining purposes. Many of these sites are not linked by existing road infrastructure and therefore new access routes and associated infrastructures need to be established resulting in an increase of regional habitat fragmentation. This will potentially result in a shrinking of the natural habitat available to fauna, an increase in ambient dust levels, and greater impacts on surface and ground water. The concentration of species leads to an increase in habitat competition which, in the long term, results in an over-utilization of the resource which eventually leads to greater habitat degradation. This may lead to the demise of habitat specific species. The presence of a number of mines in the area will increase the potential for cumulative impacts to occur on the naturally adapted species of the area.

Predicted habitat loss impacts with no mitigation measures:

- *Nature of the impact:* The impact of the road on habitat loss will be negative.
- *Intensity:* The unmitigated impact is expected to be high. The present natural processes will be altered to the extent that they temporarily or permanently cease. This will result in a deterioration of the impacted environment.
- *Extent:* The geographical extent of the impact will be local to the Swakopmund / Arandis / Trekkopje area.
- *Duration:* The lifetime of the unmitigated impact will be long-term. The impact on fauna and flora with regard to habitat loss will only cease after the operational life of the project and the area is rehabilitated. It is however expected that flora recovery will extend well beyond the life of mine due to slow recovery rates experienced in desert environments.
- *Potential for mitigation/optimization:* Moderate. The receiving environment has some mechanisms to mitigate or optimize the impact.
- *Probability:* The likelihood of the unmitigated impact occurring is highly probable as habitat loss will occur through construction activities in the road corridor and borrow pits.
- *Significance:* High – where for negative impacts the decision to proceed with the project should be with stringent mitigation measures. Mitigation measures are provided for in the EMP.
- *Frequency of occurrence:* The unmitigated impacts related to habitat loss will be time linked in that the impact of habitat loss will be once-off. However, loss to fauna through road kill will be continuous.
- *Phase:* All phases.

- *Degree of confidence in predictions:* Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.

Predicted habitat loss impacts with mitigation measures:

- *Nature of the impact:* The impact of the road on habitat loss will remain negative as habitat loss is unavoidable.
- *Intensity:* The mitigated impacts are expected to be moderate to low. The impacts will continue, but in a slightly modified way.
- *Extent:* The geographical extent of the impact will remain local to the Swakopmund / Arandis / Trekkopje area.
- *Duration:* The lifetime of the mitigated impact is expected to remain long-term. The impact on flora and flora with regard to habitat loss will only cease after the operational life of the project and the area is rehabilitated.
- *Potential for mitigation/optimization:* Remains moderate, the receiving environment has some mechanisms to mitigate or optimize the impact
- *Probability:* The impact is probable as even with mitigation measures a certain level of habitat loss will occur.
- *Significance:* Moderate to low – this impact will not be avoided but can be minimised through effective mitigation measures. The avoidance of borrow pits through the use of mine material will greatly reduce habitat loss.
- *Frequency of occurrence:* The mitigated impacts related to habitat loss will remain time linked in that the impact of habitat loss will be once-off. The loss to fauna through road kill will be continuous even with mitigation measures as it will be unavoidable.
- *Phase:* All phases.
- *Degree of confidence in predictions:* Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.

Summary of mitigation measures for habitat fragmentation and corridor restrictions

- Rehabilitation of the road disturbance corridor on closure (The unmitigated consequence is to leave the road in place on mine closure).
- Design principles for easy crossing of the road.

Predicted fragmentation and corridor restrictions impacts with no mitigation measures:

- *Nature of the impact:* The assessment is determined by the fact that the roads end point remains at the mine tenement and does not extend beyond. The fragmentation of the desert landscape in the Trekkopje area will have a negative impact.
- *Intensity:* The unmitigated impact is expected to be high. The natural processes, cultural and social functions could be altered from the current status quo to the extent that they temporarily or permanently cease, resulting in a deterioration of the impacted environment.
- *Extent:* The geographical extent of the impact will remain local the Swakopmund / Arandis / Trekkopje area.
- *Duration:* The continued presence of the road will permanently fragment the habitat in the Trekkopje / Arandis area and the impact on the receiving environment will effectively be irreversible.
- *Potential for mitigation/optimization:* The potential for mitigation/optimisation is highly / severely limited because the road will remain a permanent fixture.
- *Probability:* Should the road remain – definite. The fragmentation impact will be regardless of any preventative measures.
- *Significance:* For negative unmitigated impacts, the decision should be not to proceed with the project without stringent mitigation measures. However, on mine closure should the authorities undertake to extend the road to the Spitzkoppe community or the Henties Bay road, positive social impacts could result? Extension of the life of the road does not form part of AREVA's closure plan.
- *Degree of confidence in predictions:* With regard to corridor restrictions and fragmentation of the desert habitat – certain. With regard to post closure use of the road – unsure. Limited useful information and understanding of the environmental and social factors potentially influencing the impact on the surrounding areas and communities on mine closure is available.
- *Frequency of occurrence:* Habitat fragmentation will be continuous and permanent.
- *Phase:* all phases - impacts assessed with fragmentation will occur during all project phases from construction to post closure.

Predicted fragmentation and corridor restrictions impacts with mitigation measures:

- *Nature of the impact:* The principle mitigation measure is the removal of the road which will render the impact neutral in the long term.
- *Intensity:* The impact is expected to be low. The mitigated impact on the natural processes, cultural and social functions from the current status quo is expected to be that of nuisance value.
- *Extent:* The geographical extent of the impact will remain local to the Swakopmund / Arandis / Trekkopje area.
- *Duration:* The mitigated impact is expected to be medium term. The effects could be reversed over a medium time period, possibly coinciding with the life of the project.
- *Potential for mitigation/optimization:* The potential for mitigation/optimisation is high. The intensity of the impact is low and the receiving environment has the capacity, resources and mechanisms to mitigate or optimize the impact.
- *Probability:* low - the possibility of the impact materialising is low to unlikely.
- *Significance:* Low, this impact will be avoided with general mitigation measures and the removal of the road on mine closure.
- *Degree of confidence in predictions:* With regard to corridor restriction and fragmentation of the desert habitat – certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.
- *Frequency of occurrence:* Time-linked to the life of the project.
- *Phase:* all phases - impacts assessed with fragmentation will occur during project phases from construction to closure.

Indirect Impacts: Summary of mitigation measures

- Effective design of drainage channels
- No private access
- Ensure that vehicles are serviced regularly and have no leaks.
- Effective emergency response plan
- No fires to made on route
- Ensure that no alien plant and animal species are introduced, particularly from containers imported from foreign countries.

Predicted indirect impacts with no mitigation measures:

- *Nature of the impact:* The impact will be negative.
- *Intensity:* The indirect impact is expected to be high to moderate. The natural processes could be altered from the current status quo in a modified way.
- *Extent:* The geographical extent of the impact will remain limited to the Trekkopje mine and project area.
- *Duration:* Long term. The impact will only cease after the operational life of the project and the area is rehabilitated.
- *Potential for mitigation/optimization:* The potential for mitigation/optimisation is high.
- *Probability:* Probable to unlikely. There is a possibility that the indirect impacts will occur.
- *Significance:* High to moderate. The indirect impacts will not be avoided unless mitigation measures are put in place and could require modification of the project design.
- *Degree of confidence in predictions:* Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.
- *Frequency of occurrence:* Without mitigation the indirect impacts will be continuous.
- *Phase:* all phases – indirect impacts will occur during all project phases from construction to post closure.

Predicted indirect impacts with mitigation measures:

- Nature of the impact: The impact will remain negative.
- *Intensity:* The indirect impact is expected to be low to moderate. The natural processes could be altered from the current status quo in a slightly modified way.
- *Extent:* The geographical extent of the impact will remain limited to the Trekkopje mine and project area.
- *Duration:* Long term. The impact will only cease after the operational life of the project and the area is rehabilitated.
- *Potential for mitigation/optimization:* The potential for mitigation/optimisation is high.
- *Probability:* Unlikely. There is a low possibility that indirect impacts will occur
- *Significance:* Low. The impacts will be avoided with general mitigation measures.
- *Degree of confidence in predictions:* Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.

- *Frequency of occurrence:* With mitigation the impacts will be intermittent – occurring from time to time.
- *Phase:* all phases – indirect impacts could occur during all project phases from construction to post closure.

Summary

It is inevitable that through road construction activities the impacts related to the loss of fauna and flora and fragmentation of the habitat will occur. In order for these impacts not to remain permanent the recommendation from a biophysical point of view is to remove the road on mine closure and rehabilitate the disturbance corridor to allow the habitat to return to its pre-mining state. However, the possibility does exist that new mines will come in to existence prior to the closure of Trekkopje mine that would possibly be able to make use of the road and thereby avoid construction of additional access routes. Furthermore, the presence of the road may have social benefits unrealised at the present moment. The road is planned as a dead-end destination, but may be extended to Spitskoppe or the Henties Bay access road. The most important aspect with regard to the impacts detailed above is that effective mitigation measures be applied in order to minimise the predicated impacts.

8.5 Evaluation of Air Quality Impacts

At present no human activities occur in the immediate area of the road route, other than the periodic inspection of the temporary pipeline. Significant crusting of the soil minimises the frequency of windblown dust. This dust would therefore only occur under strong wind conditions. Although the possibility of naturally occurring windblown dust cannot be excluded, it would be reasonable to assume that future air impacts would primarily be due to road construction. Once the construction phase is completed the road will be bitumen surfaced and therefore not create any dust.

The main effects of the construction of the road on air quality will be the temporary creation of dust, during the construction period. Carbon emission and fume pollution from traffic activities are discussed below in section 8.5.2

8.5.1 Impact assessment - dust

Direct impacts

The construction of the road will result in increased dust levels, from site clearance and preparation, use of heavy equipment, traffic, and stockpiling of soil for future use. The generation of high levels of dust will be sporadic, and associated with specific activities as outlined above. Dust will be generated through on-site activity and traffic loads throughout the construction phase. The potential for erosion –

primarily wind – is increased, specifically during the construction phase with dust effects being localised.

Cumulative Impacts

It is likely that the construction of the road will be the catalyst for the development of an industrial development zone in Arandis. Depending on the nature of future infrastructure and industries, the impacts on air pollution could increase significantly, primarily through:

- Dust during construction
- Dust, fumes and emissions from increased traffic into and out of the area, and
- Pollutant emissions from the operations, depending on the types of industry that are allowed to establish themselves in the area.

Summary of mitigation measures

- Covering of soil stockpiles.
- Wetting of surfaces prior to grading, and stripping.
- Ongoing wetting of access road surfaces.

Predicted impacts with no mitigation measures:

- *Nature of the impact:* The impact will be negative.
- *Intensity:* The generation of dust during construction will be unavoidable. The resultant unmitigated impact is expected to be moderate to high. The natural processes could be altered from the current status quo in a modified way.
- *Extent:* The geographical extent of the impact will remain local the Swakopmund / Arandis / Trekkopje area.
- *Duration:* Temporary. During construction (can have temporary effects during operation as well).
- *Potential for mitigation/optimization:* The potential for mitigation/optimisation is high.
- *Probability:* Definite. Without mitigation measures dust impacts will more than likely occur.
- *Significance:* High to moderate. The unmitigated impacts will not be avoided unless defined mitigation measures are put in place.
- *Degree of confidence in predictions:* Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.
- *Frequency of occurrence:* Time-linked. Dust impacts will occur when construction activities related to soil disturbance takes place, as well as transport of material on access roads.
- *Phase:* Construction.

Predicted impacts with mitigation measures:

- *Nature of the impact:* The impact will be negative. It will be extremely difficult to construct a road without generating some sort of dust.
- *Intensity:* With mitigation due to regular wetting the impact is expected to be low. The natural processes could be altered from the current status quo in a slightly modified way.
- *Extent:* The geographical extent of the impact will remain limited to the Arandis / Trekkopje mine project area.
- *Duration:* Temporary. During construction (can have temporary effects during operation as well).
- *Potential for mitigation/optimization:* The potential for mitigation/optimisation is high through the adequate spraying of water.
- *Probability:* Probable. Without mitigation measures dust impacts will occur. The availability of adequate supply of water remains a constraining factor.
- *Significance:* Moderate. The impacts will not be avoided unless defined mitigation measures are put in place.
- *Degree of confidence in predictions:* Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.
- *Frequency of occurrence:* Time-linked. Dust impacts will occur when construction activities related to soil disturbance takes place, as well as transport of material on access roads.
- *Phase:* Construction.

Summary

With sufficient application of water to working surfaces dust related impacts should not be significant beyond that of nuisance value. A certain level of human impact may be experienced in Arandis; however with the prevailing wind, impacts should be minimal. The adequate supply of water is a potential constraint to effective dust management.

8.5.2 Evaluation of vehicle emission factors

The emission of pollutants by vehicles has worldwide impacts and contributes greatly to the total atmospheric pollution generated by people. Pollution by motor vehicles plays a significant role in a serious global problem. Consequently it is becoming expected to include potential project related emission factors and the possible influence / contribution to global impacts.

Air mass Contaminants

The main products of the combustion of motor fuels are carbon dioxide and water, but inefficiencies and high temperatures inherent in engine operation encourage the production of many other pollutants of varying effect. The major pollutants of significance to roadside air quality in vehicle emissions are:

- *Nitrogen oxides (NOx)*. Most of the NOx in vehicle emissions are in the form of NO (nitric oxide), which is a by-product of fuel combustion under conditions of extreme heat and pressure, typical of combustion chambers. Once released from the tailpipe, NO is oxidized to NO^2. In conjunction with SO^2, NOx plays a major role in the formation of acids in the atmosphere. NOx also react with hydrocarbons in the presence of sunlight to produce photochemical smog.
- *Hydrocarbons (HC)*. These are produced by the incomplete combustion of fuel and by its evaporation. Their production is strongly influenced by fuel composition. Hydrocarbons include many organic chemical substances, the most notorious of which are benzene and ethylene. Hydrocarbons combine with NOx to produce photochemical smog.
- *Carbon monoxide (CO)*. Carbon monoxide is one result of incomplete combustion. Diesel engines produce far lower emissions of both CO and HC than do gasoline engines.
- *Sulphur dioxide (SO_2)*. The emission rate of SO_2 is directly linked to the sulphur content of the fuel. Diesel engines produce more SO^2 than do gasoline engines. In conjunction with NOx, SO_2 is involved in the formation of acids in the atmosphere.
- *Particulates*. This diverse group consists of carbon nuclei onto which various compounds are adsorbed. Typical particulates include suspended airborne particles from diesel fuel combustion, materials produced by tire, brake and road wear, and dust.
- *Lead (Pb)*. Added to gasoline to raise the octane rate and help lubricate engine components, lead enters the atmosphere as a fine dust which is easily dispersed and settles on any available surface. Not present in Namibian fuels.
- *Aldehydes*. The aldehydes, including formaldehyde, are a major pollutant group associated especially with engines burning alcohol. They are also produced by diesel engines and, to a lesser degree, by gasoline combustion.
- *Secondary pollutants*. Many primary pollutants are transformed into secondary and tertiary pollutants (See FIGURE 8.4) through various chemical reactions linked to meteorological factors, air temperature, humidity, and the topography of the site. One example of this is the reaction of NOx and HC in

the presence of sunlight to produce ozone (O^3) which, although beneficial in the stratosphere, is a well-documented nuisance at ground level.

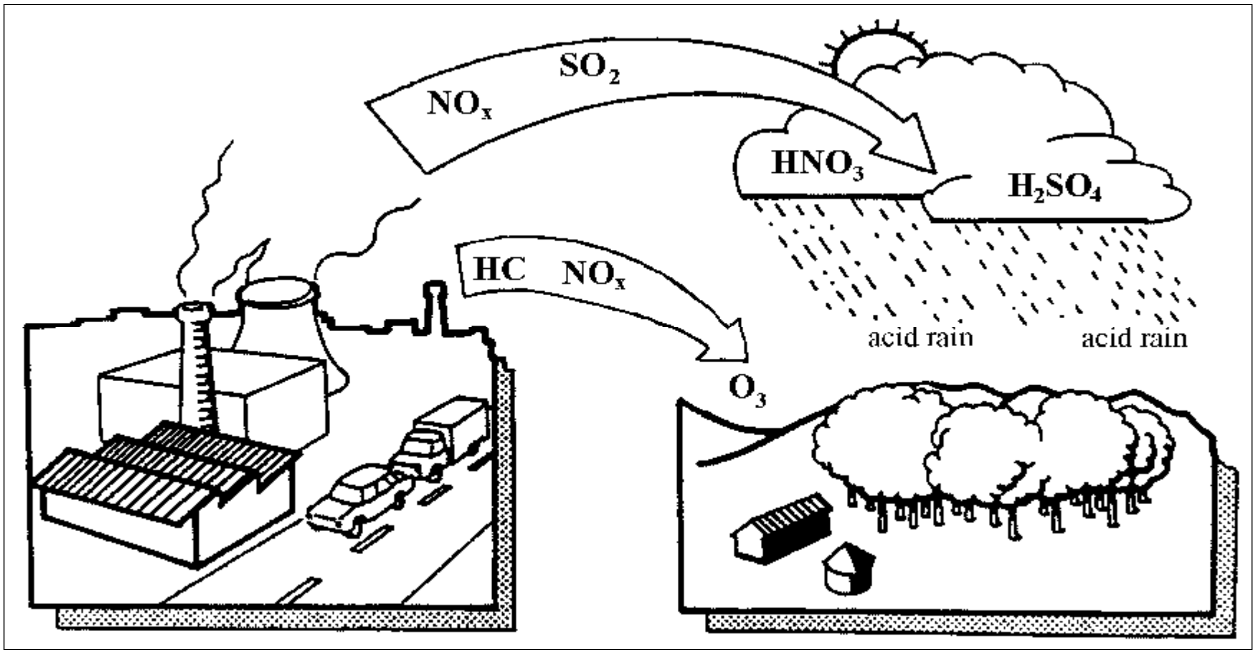
Movement of pollutants

A three-part process describes the mechanism by which the use of motor vehicles affects the lives of humans through the air (see FIGURE 8.5). The three steps in the process are a) emission, b) dispersion, and c) reception.

Emission

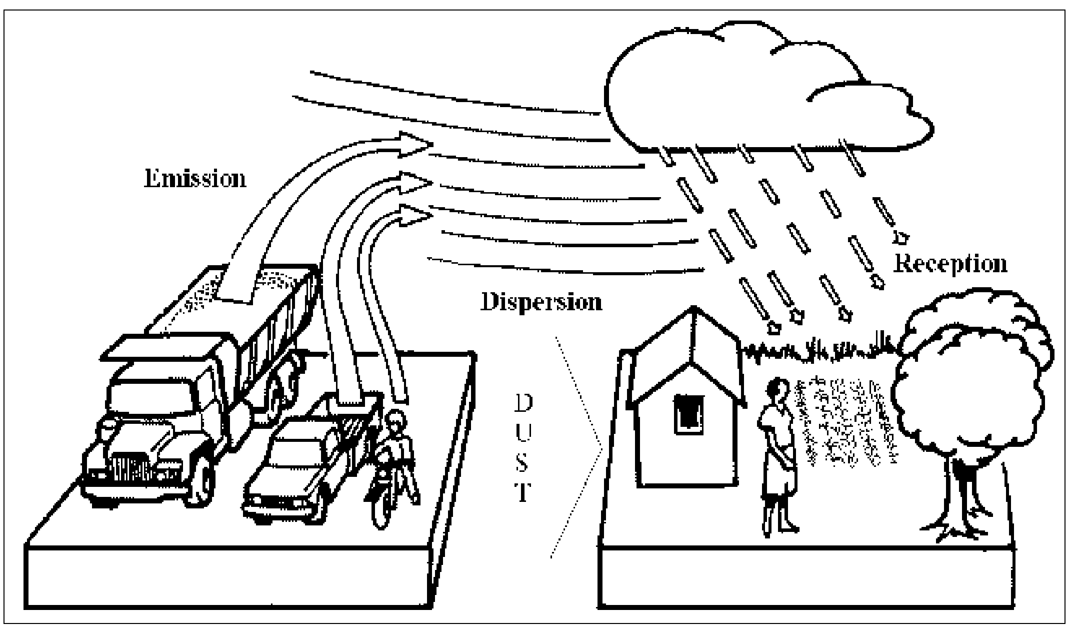
The volume and composition of individual vehicle emissions are determined by the following factors:

- *Fuel composition*. Sulphur content of diesel fuel, as well as lead content and benzene levels in gasoline, has a significant influence on the concentration of those pollutants in the emissions.
- *Level of engine maintenance*. Poorly adjusted timing, dirty and malfunctioning fuel systems, dirty air cleaners, and tampering with pollution control devices are just a few of the maintenance factors which can increase emissions, primarily through incomplete combustion.
- *Vehicle age*. Emissions control technology has improved over the years, and there is a close relationship between the age of engine and exhaust technology in a vehicle fleet and the total air emissions produced. Fleets with predominantly older vehicles produce much higher levels of emissions than do newer fleets of the same size.
- *Engine temperature*. Cold engines run inefficiently, and catalytic converters on gasoline engines do not function at all until normal operating temperatures are attained.
- *Road geometry*. Engines produce higher emissions while decelerating, accelerating, and climbing grades, so any road features which encourage these actions also encourage higher emissions.
- *Type of vehicle*. Heavy vehicles with large engines emit more pollutants than do lighter, less powerful ones. Diesel engines produce large amounts of SO_x, NO_x, and particulates, while gasoline engines are larger producers of CO and hydrocarbons.
- *Speed and congestion*. The majority of vehicles operate most efficiently at constant cruising speeds of between 80 and 100 km/hr.



Source: World Bank – Roads and the Environment: A Handbook

FIGURE 8.4 – SIMPLIFIED DIAGRAM OF INTERACTIONS BETWEEN VARIOUS AIR POLLUTANTS



Source: World Bank – Roads and the Environment: A Handbook

FIGURE 8.5 – THE EMISSION PROPAGATION PROCESS

Dispersion

Dispersion of pollutants is dictated by the following factors:

- *Prevailing wind direction*. Concentration of pollutants is greatest downwind of the road. Pollution sources upwind of a road should be considered in an assessment of pollutants for the road site.
- *Weather conditions*. Wind speed, rainfall, humidity and temperature all have an effect on rates of pollutant dispersion.
- *Roadside vegetation*. The height and density of roadside plants determines their ability to filter pollutants from the air.
- *Topography*. Roadside landforms can affect dispersal in any number of ways, from being physical barriers to modifying wind speed and direction.
- *Distance from road*. All other factors being equal, pollutant concentration decreases with increasing distance from the road.

Reception

Pollutants in the air shed of a road are:

- Inhaled directly from the air.
- Ingested when humans eat food crops grown near busy roads and which have had particulates settle on them.
- Ingested, when humans touch surfaces in their environment and then make contact with their mouths while eating or playing (Lead commonly finds its way into children's bodies in this way).
- Washed out of the air by falling raindrops and deposited as acid precipitation.

8.5.3 Trekkopje Mine vehicle movement

The following section provides a comparison of the potential environmental impact of vehicle emissions between the current access road and the planned new road. The assessment uses the distance from Arandis to the current mine offices via Trekkopje siding – 62 kilometres (one way) and 124 kilometres return and from Arandis to the current mine office using the planned new route – 32 kilometres (one way) and 64 kilometres return.

In order to determine the estimated vehicle emissions currently experienced by the Trekkopje mine operation (excluding vehicular movement related to physical mining) a monthly average was determined. TABLE 8.2 below shows the average vehicle movement for the month of July 2009 using the current mine access road from Trekkopje siding. To compare the various environmental aspects and emissions, the environmental impact is determined using a standard environmental load unit (ELU).

TABLE 8.2 – MINE TRAFFIC JULY 2009	
Vehicle	Average number of trips for the month
Light Delivery Vehicle (1 person)	941
Light Delivery Vehicle (More than 1 person)	1299
Mini bus	87
Large bus	504
Truck	80

At present the Trekkopje operation is in construction phase, therefore no product is being exported off the mine site. The truck fuel consumption has been determined as an average between full load consumption and empty consumption. Busses are used to transport mine personnel on a 24-hour shift basis from Swakopmund and Arandis and travel both directions with a full compliment. The Tables 8.4 to 8.8 provide a comparison of the expected vehicle emissions. In order to provide a balanced comparison of the two routes; namely, the current access road, and the proposed new road, the vehicular traffic experienced for the month of July 2009 to Trekkopje mine has been used as a basis. TABLE 8.3 provides for the estimated diesel fuel consumption of heavy transport trucks and busses for the month of July 2009 using average per kilometre consumption.

TABLE 8.3 – HEAVY VEHICLE FUEL CONSUMPTION				
CURRENT ACCESS ROAD – 124 KILOMETRES				
	No of trips	**Km travelled**	**Ave fuel consumption**	**Total litres used**
Trucks	80	9 920	2 km / litre	4 960
Busses	504	62 496	3.2 km / litre	19 530
PROPOSED NEW ACCESS ROAD – 64 KILOMETRES				
	No of trips	**Km travelled**	**Ave fuel consumption**	**Total litres used**
Trucks	80	5 120	2 km / litre	2 560
Busses	504	32 256	3.2 km / litre	10 080

[8]TABLE 8.4 provides a comparison of the expected emissions and environmental load units for the trucks and busses.

[8] **Template used from: Zackrisson M, Bengtsson G, & Norberg C, *Measuring Your Company's Environmental Impact: templates & tools for a complete ISO14001 initial review.* Earthscan 2004**

TABLE 8.4 – EMISSIONS FOR HEAVY TRANSPORT VEHICLES AND BUSSES									
CURRENT ACCESS ROAD – 124 KILOMETRES									
	HC (kg)	**CO (kg)**	**NOx (kg)**	**PM (kg)**	**SO² (kg)**	**CO² (tons)**	**Energy oil (MWh)**	**Total resource consumptio n (MWh)**	**ELU**
Trucks	13	23	253	4.8	9.7	15.1	54.1	54.1	4 786
Bus	50	92	995	19.0	38.0	59.2	213.1	213.1	18 884
Total	**63**	**115**	**1 248**	**23.8**	**47.7**	**74.3**	**267.2**	**267.2**	**23 670**
PROPOSED NEW ACCESS ROAD – 64 KILOMETRES									
Trucks	7	12	130	2.5	5.0	7.8	27.9	27.9	2 470
Bus	26	47	514	9.8	19.6	30.6	110	110	9 727
Total	**33**	**59**	**644**	**12.3**	**24.6**	**38.4**	**137.9**	**137.9**	**12 197**

*HC – hydrocarbons, CO – carbon monoxide, NOx – nitrogen oxides, PM – particulate matter, SO² - sulphur dioxides, CO² - carbon dioxide

The following TABLE 8.5 provides the average fuel consumption for light delivery vehicles such as double cabs and sedans.

TABLE 8.5 – LIGHT VEHICLE FUEL CONSUMPTION				
CURRENT ACCESS ROAD – 124 KILOMETRES				
	No of trips	**Km travelled**	**Ave fuel consumption**	**Total litres used**
Light Delivery Vehicle (1 person) Diesel	941	116 684	9 km / litre	12 964
Light Delivery Vehicle (More than 1 person) D	1299	161 076	9 km / litre	17 897
Mini bus (Petrol)	87	10 788	9.5 km / litre	1 135
PROPOSED NEW ACCESS ROAD – 64 KILOMETRES				
	No of trips	**Km travelled**	**Ave fuel consumption**	**Total litres used**
Light Delivery Vehicle (1 person) Diesel	941	60 224	9 km / litre	6 691
Light Delivery Vehicle (More than 1 person) D	1299	83 136	9 km / litre	9 237
Mini bus (Petrol)	87	5 568	9.5 km / litre	586

TABLE 8.6 provides the expected emission loads for light delivery vehicles for the month of July 2009.

TABLE 8.6 – EMISSIONS FOR LIGHT DELIVERY VEHICLES								
CURRENT ACCESS ROAD – 124 KILOMETRES								
	Litre fuel	**HC (kg)**	**CO (kg)**	**NOx (kg)**	**CO² (kg)**	**Energy oil (kWh)**	**Total resource consumption (MWh)**	**ELU**
Petrol	1 135	1.0	6.4	1.2	2 638	9 900	10	727
Diesel	30 861	22.8	173.8	271.6	80 393	301 752	302	22 644
Total	**31 996**	**24**	**180**	**273**	**83 031**	**311 652**	**312**	**23 371**
PROPOSED NEW ACCESS ROAD – 64 KILOMETRES								
Petrol	586	0.5	3.3	0.6	1 362	5 111	5.1	376
Diesel	15 928	11.8	89.7	140.2	41 492	155 740	155.7	11 687
Total	**16 514**	**15**	**93**	**140.8**	**42 854**	**160 851**	**160.8**	**12 063**

TABLE 8.7 provides the estimated total emissions and environmental load units for the month of July 2009 for all vehicles moving on the current Trekkopje mine access road with a comparison of what it would have been on the new access road. This table only provides for vehicular traffic and does not take into account the additional emissions of rail transport from Arandis to the Trekkopje siding.

TABLE 8.7 – TOTAL ENVIRONMENTAL LOAD UNITS							
	HC (kg)	**CO (kg)**	**NOx (kg)**	**CO2 (tons)**	**Energy oil (MWh)**	**Total resource consumption (MWh)**	**ELU**
Total current access	**87**	**295**	**1 521**	**157.3**	**578.8**	**579.2**	**47 041**
Total new access road	**48**	**152**	**663**	**81.2**	**298.7**	**298.7**	**24 260**

Human health impacts

The health impacts of motor vehicle air pollution are difficult to quantify and, therefore difficult to value in economic terms. In many cases, establishment of direct cause-and-effect linkages between localized automotive air pollution and specific illnesses is problematic. However, evidence does strongly suggest that exposure to several of the major emission constituents is responsible for certain health conditions. A consequence for Arandis is that the prevailing wind is south-westerly and will move contaminants generally away from the town. The Benguela current along the west coast produces an inland movement of cold air. At present there are no significant human activities or communities in most of the area traversed by the proposed new access route.

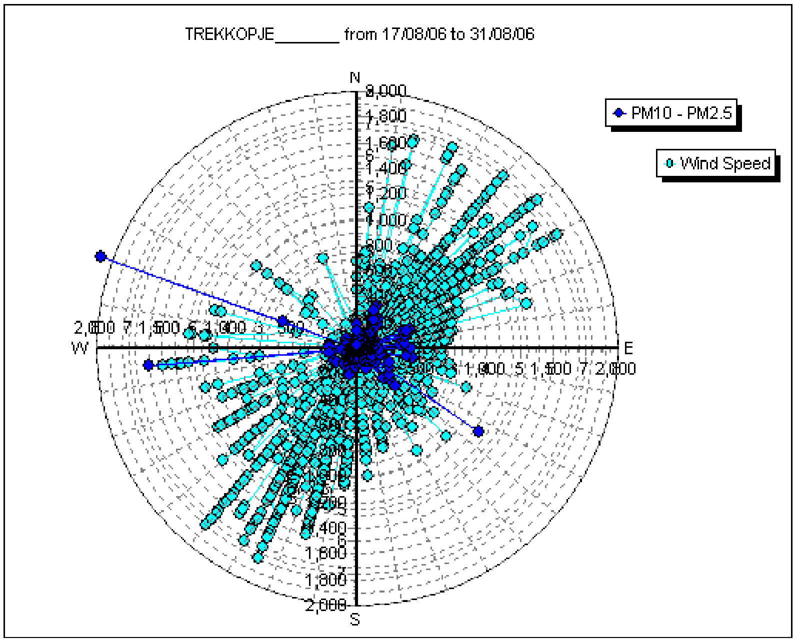


FIGURE 8.6 – ROSE DIAGRAM SHOWING THE WIND SPEED AND PREVAILING WIND DIRECTIONS AT TREKKOPJE FOR THE PERIOD 17TH AUGUST TO 31ST AUGUST 2006

Flora impacts

Plants, domesticated and wild are affected both physically and chemically by air pollutants. Dust settles on leaves and can interfere with pollination and photosynthetic function if the accumulation is significant. Ethylene, a hydrocarbon, has a detrimental hormonal influence on plant growth, while NOx, SO^2 and ozone can all cause localized death of leaf tissue (leaf necrosis). Finally, plants can absorb toxic pollutants such as lead from the air, making the consumption of these plants hazardous.

Fauna impacts

Although most of the research efforts concerning pollutants' effects on animals have focused on human health, some faunal health problems have been connected to air pollution. With regard to humans, there are mostly respiratory problems.

Summary

It is clearly evident that the new access road will have substantially less impacts related to vehicle emissions. An emission impact that has not been calculated in the comparison is the (should the siding at Trekkopje be used as would occur if the current access road was upgraded) diesel fuel emissions from the trains used in the bulk transport of chemicals.

8.6 Evaluation of Noise Impacts

Noise related to road development can be determined through four principle sources:

- Vehicles
- Friction between vehicles and the road surface
- Driver behaviour
- Construction and maintenance activity

- *Vehicle noise*: Vehicle noises originate mainly from the engine, transmission, and exhaust brakes. The noise output is the highest during acceleration, on upslope, during engine braking and slowing down, on rough roads, and in stop-and-go traffic conditions. Poor vehicle maintenance contributes to greater noise outputs.
- *Road noise*: Friction caused by contact between the tires and the road surface adds to traffic noise. The level of noise depends on the type and condition of tires and pavement. Frictional noise is the highest at high speed and through rapid braking.
- *Driver behaviour*: Drivers using hooters, playing loud music, by causing their tires to squeal as a result of sudden braking or acceleration, contribute to road noise.
- *Construction and maintenance*: Construction and maintenance activities require the use of heavy machinery.

8.6.1 Environmental impacts of road noise

[9]*Human welfare*: Even when it is not perceived consciously, chronic exposure to road noise can affect human welfare in varying degrees, both physiologically and psychologically. Chronic noise exposure can be a source of annoyance, creating communication problems and leading to elevated stress levels as well as associated behavioural and health effects. It can cause auditory fatigue, temporary and permanent lessening of hearing ability, sleep disorders, and can even contribute to learning problems in children.

The specialist study undertaken indicates that the present ambient noise levels in Arandis are typical for a rural community and are determined by communal activities, local traffic and natural noise sources, such as the interaction of the wind with the foliage of trees. During construction it is expected that there will be no increase in ambient noise level in Arandis itself and the total resulting ambient noise levels during the day and night will effectively remain unchanged. As a result there should be no community response to the noise emissions from the construction activities. However, at the hospital the increase in ambient noise level will be between 3 dB and 5 dB, resulting in 'little' community response with 'sporadic complaints.' In this

[9] ***Roads and the Environment: A Handbook***

regard the road alignment has been altered and moved further east in order to minimise any impact on the hospital. See FIGURE 8.7

Vibration: The vibration induced by the resonance of traffic noise can have a detrimental effect on structures standing near the road. There are no structures in close proximity to the proposed road.
Wildlife disturbance: Noise may prevent many animal species from approaching or crossing road corridors. As a result, road corridors become barriers to regular wildlife travel routes, effectively rendering roadside habitat areas inaccessible to some species. Such disturbance reduces the success of these species and contributes to ecological alteration. The proposed road will have wildlife impacts associated with road noise; however the greatest concentration of vehicular traffic will be during daylight hours.
Environmental factors: Weather conditions such as temperature, humidity, wind speed, and prevailing wind direction can play a role in determining how individual sites are affected by road noise. Temperature and humidity determine air density, which in turn affects the propagation of sound waves. Downwind sites are generally exposed to greater noise levels than are sites upwind of roads. Ambient noise levels, associated with industrial and other human activity, affect the perception of the magnitude of the road noise impact. In areas with low ambient noise levels such as Arandis, the noise from a new road development will generally be more noticeable than a similar noise level would be in an environment with higher ambient noise levels.
Spatial relationships: Perhaps the greatest determinant of noise impacts is the spatial relationship of the road to potential noise receptors - the closer the road to receptors, the greater the impact. Accept in close proximity to Arandis the road will not impact on any communities.
Traffic stream; vehicles tend to be noisier in stop-and-go traffic; and the speed of traffic flow - noisiest at high speeds. Ambient noise levels are generally lowest at night, and if traffic noise peaks at night, the impact will be great. Conversely, if traffic noise peaks at the same time that ambient noise levels do, the effects will be less noticeable. The greatest traffic load on the new access road will be during daylight hours.

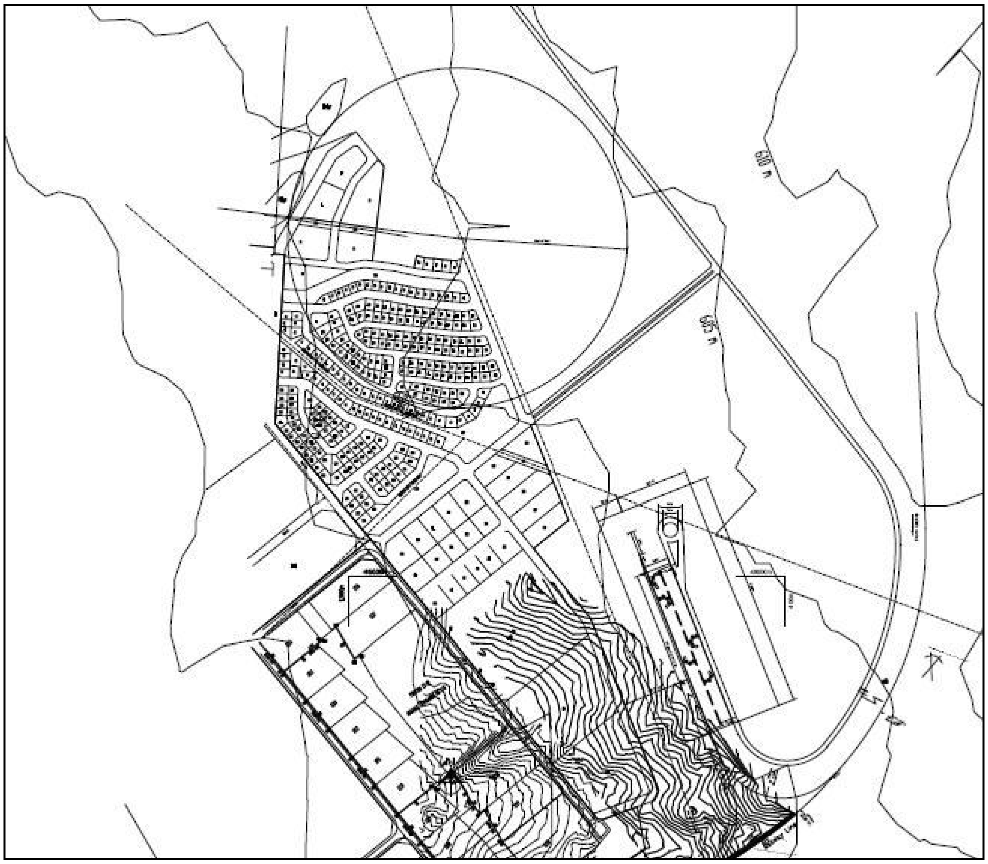


FIGURE 8.7 – PROPOSED NEW ROAD DEVELOPMENT

8.6.2 Impact assessment

The noise measurements were taken in accordance with the methods stipulated by the SANS 10103. In this respect the methods are compliant with internationally accepted good measurement practice as described in the guidelines provided by the World Health Organisation (WHO) and the requirements of ISO 1966.

The noise emissions were calculated for the following conditions:

- Construction of the road. The construction activities take place at a location nearest to the town, i.e. directly opposite the Arandis hospital. The noise sources include a bulldozer, grader, roller and construction vehicles.
- Operation of the road. The noise emissions are caused by traffic on the road, consisting of heavy (e.g. transport trucks) and light (LDV's) vehicles. The former travel at a speed of 80 km/h and the latter at 100 km/h.

Summary of mitigation measures

Although the intensity of the noise impact for the unmitigated operational phase is only low to moderate the increase in ambient noise level at the hospital will be significant.

- The use of a finer textured road surface texture for the section of road that passes close to Arandis, specifically the hospital.
- Design the road further west from the current temporary pipeline. This has been undertaken as part of early design. In the event of the road remaining adjacent to the temporary pipeline opposite the hospital - place of an effective noise barrier with a minimum height of 2,5 m above ground level on the Arandis side of the road.

Direct impacts

Increase of ambient noise levels as a result of construction activities and road operational activities detrimentally affecting human health in the general surrounds of Arandis and particularly at the hospital. An increase in the ambient noise level in the desert environ due to operational activities can have an impact on animal movement and migration activities.

Cumulative Impacts

The possibility does exist that the general ambient noise level in the Arandis may increase. However the specialist study indicates that it would not be a significant increase.

Predicted impacts with no mitigation measures:

- *Nature of the impact*: The impact will be negative to neutral.
- *Intensity*: The impact is low to moderate. The impact has no effect on natural, cultural and social functions and processes beyond that of nuisance value or in a slightly modified way.
- *Extent*: The geographical extent of the impact will remain limited to the Trekkopje mine project area, Arandis and the road corridor.
- *Duration*: Long term. The impact will only cease after the operational life of the project.
- *Potential for mitigation/optimization*: The potential for mitigation/optimisation is moderate to high. The intensity of the impact is low to moderate and the receiving environment has the capacity, resources and mechanisms to mitigate or optimize the impact.
- *Probability*: Probable. There is a possibility that the impact will occur
- *Significance*: Low. The impacts will be avoided with general mitigation measures.

- *Degree of confidence in predictions*: Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.
- *Frequency of occurrence*: Without mitigation the impacts will be continuous.
- *Phase*: construction, operation and closure.

Predicted impacts with mitigation measures:

- *Nature of the impact*: The impact will be neutral.
- *Intensity*: The impact is expected to be low. The impact has no effect on natural, cultural and social functions and processes beyond that of nuisance value.
- *Extent*: The geographical extent of the impact will remain limited to the Trekkopje mine and project area.
- *Duration*: Long term. The impact will only cease after the operational life of the project and the area is rehabilitated.
- *Potential for mitigation/optimization*: The potential for mitigation/optimisation is high.
- *Probability*: Unlikely. There is a low possibility that the impact will occur as the road design has taken into account a greater buffer zone.
- *Significance*: Low. The impacts will be avoided with general mitigation measures.
- *Degree of confidence in predictions*: Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.
- *Frequency of occurrence*: With mitigation the impacts will be intermittent – occurring from time to time.
- *Phase*: construction, operation and closure.

Summary

The road has been preliminarily designed to be further west than the current temporary pipeline in order to accommodate any future expansion of Arandis and to minimise the possible impact of operational noise. In this regard, the presence of the road is not expected to have noise related impacts.

8.7 Evaluation of archaeological impacts

Archaeological surveys and assessments have been carried out at all stages of the Trekkopje mine development, including the temporary water supply line corridor to be enlarged by the access road project. A field survey specialist study was undertaken as part of the environmental impact assessment process for the new road.

The survey identified eleven archaeological sites of which nine are associated with harvester ant seed caches. These sites are not archaeological occupation sites but indicators of such sites that possibly occur within a 4 km radius. See APPENDIX V for the detailed archaeological report. The impact of the Trekkopje access road on the archaeology of the area will be mainly in the context of construction work. Sites located in the path of the access road will be destroyed, and there may be further indirect impacts resulting from a lateral disturbance on either side of the route itself.

In either case, these impacts will result in the permanent loss of the archaeological sites. However, this loss of archaeological evidence has to be considered against the significance of the sites in terms of their rarity and the amount of additional evidence that might be conserved or gained by their preservation, or by carrying out detailed mitigation work. The significance rating of the sites is between 1 and 2 on the zero to 5 scales employed in Namibian archaeological assessment (See Appendix I of Archaeological Specialist Report – APPENDIX V of this report). A rating of 1 signifies a disturbed or secondary context, while a rating of 2 signifies an isolated minor find. All seed digging sites are rated as 2, meaning that they do not justify mitigation. In terms of vulnerability, all of the sites reported are rated 3 on the scale employed in Namibian archaeological assessment (See Appendix I of Archaeological Specialist Report – APPENDIX V of this report). This rating indicates a probable threat of destructive impact. A higher rating can only be considered when the centreline of the access road is surveyed and marked and when the exact footprint of the borrow pits and construction tracks are known. However, even a maximum vulnerability rating would not necessarily justify mitigation measures to be taken in this case, since the significance of the sites is very low.

8.7.1 Impact assessment

Direct impacts

The construction of the road will result in the destruction of the sites within the disturbance corridor.

Indirect Impacts

Impacts resulting from lateral disturbance on either side of the route may result in disturbance of sensitive sites.

Summary of mitigation measures

- Disturbance corridor to remain as narrow as possible
- No movement of vehicles or people outside the road corridor
- Uncovering of artefacts to be immediately reported.

Predicted impacts:

- *Nature of the impact*: The impact will be negative. Sites will be permanently destroyed
- *Intensity*: The impact is expected to be high. The impact will result in total or near-total destruction of the sites.
- *Extent:* The geographical extent of the impact will remain limited to the road route.
- *Duration:* Permanent. The impact will be permanent as the sites will be destroyed due to construction activities.
- *Potential for mitigation/optimization:* The potential for mitigation/optimisation is low.
- *Probability*: Very high. There is a very high probability of impact for any site located in the road route.
- *Significance:* Low. A rating of 1 signifies a disturbed or secondary context, while a rating of 2 signifies an isolated minor find. All seed digging sites are rated as 2, meaning that they do not justify mitigation.
- *Degree of confidence in predictions:* Certain. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.
- *Frequency of occurrence:* The impacts will be once-off but continuous in nature.
- *Phase:* Construction.

Summary

Due to the relatively low significance of the sites on the proposed route detailed mitigation measures are not required.

8.8 Land Surface Impacts – Borrow Pits

The land surface is the substrate on which the majority of ecological processes occur. Physical disturbance of this surface and the underlying soil, whether surface (e.g. scarification) or fundamental (e.g. excavation) can dramatically affect ecosystems.

The Trekkopje area is underlain by the thick sequence of Kuiseb Formation schist and is an intercalated mica-schist, quartzite and meta-greywacke. The landscape is dominated by the typical morphology of a vast peneplain where sediments of the Namib Desert form a thin cover to the Proterozoic rocks. The peneplain is dissected by numerous dry riverbeds, draining towards the coast. South of the Trekkopje tenement, ephemeral rivers dewater into the Swakop River. Calcrete capping the Namib sediments can be observed in incisions made by the small rivers draining into the Swakop River valley. Calcrete is a hard surface limestone, common in warm, arid and semi-arid regions, where it builds up by solution and re-deposition of lime. The lime commonly cements sand and gravel beds, and can even partly replace older sediments.

8.8.1 Local Conditions

Construction for the proposed new access road requires the use of fill material that will principally be sourced from two avenues; borrow pits and mine overburden material. An additional source of fill material is from cutting V-sections through ridges and filling the required areas with the material. This form of material source alters the natural relief and morphology of the landscape permanently and therefore has been discarded as an option for the Areva road. The formation of major cut and fill zones will be extremely difficult to rehabilitate and will be out of character with the terrain.

Bitumen surfaced roads require large amounts of fill material in various layers and thicknesses. These layers are required to provide a stable platform to carry the intended loads and for the integrity of the road to remain intact under such loads and use conditions. Where the road crosses over drainage lines, washes and dry riverbeds concrete structures are placed to divert and channel the water. The borrow pit material is required to fill the voids in order to remain within the profile of the road.

The estimated borrow pit material required for the Trekkopje mine access road from Arandis is as provided in TABLE 8.8.

TABLE 8.8 – BORROW PIT MATERIAL PREFERRED ALTERNATIVE

Material required	m^3/km	32 km
Base layer source (Crushed stone)	1 200	16 000
Shoulder layer source (Natural gravel)	500	16 000
Sub-base layer source (C/stone & gravel)	3 600	115 200
Selected layer source (Selected gravel)	3 900	124 800
Fill material source	10 500	336 000
	Total m^3	608 000

The proposed road from Arandis to Trekkopje Mine would require an estimated total of 608 000 m^3 of various forms of fill material.

Two site visits were undertaken to determine appropriate borrow pit sites. The route between Arandis and Trekkopje mine was divided into three zones. Zone one is the area from Arandis to the first major ridge, a distance of approximately 5.5 straight line kilometres. The town of Arandis is included in zone 1 as the possibility of excavating a borrow pit to be used as a future domestic waste landfill site was undertaken. Zone two is the area between the 1st ridge and the 4th (last) ridge, a distance of approximately 10 straight line kilometres. Zone three is area between the last ridge (4th ridge) and the mine office, a distance of approximately 12 straight line kilometres. In addition to the two site assessments the biodiversity and archaeological specialists undertook a site visit after the first assessment. During the second field assessment a hand auger was used to excavate shallow pits in order to determine the approximate depth of available and suitable material.

Zone 1: The availability of a suitable borrow pit site in this area is limited due to the limited depth of the required deflation gravels. On average the depth of the surface gravels is between 20 and 50 cm before striking bedrock. See FIGURE 8.8. The area is dissected by a network of numerous shallow east to west drainage channels and washes. These are relatively narrow with sandy channels, with the remainder being rocky and stony channels.

FIGURE 8.8 – DEPTH OF GRAVELS ZONE 1

Due to the lack of depth of available material, borrow pits in this area and in close proximity to the road route and Arandis town would require a large area of excavation. Potentially the excavations would be in excess of 200 m x 200 m and would on average not be deeper than 0.5 meters. Numerous small channels and drainage lines would be bisected. The excavation will result in the loss of a large area of natural habitat, as well as stream-flow disruption of numerous washes and drainage lines. The excavation of a borrow pit close to Arandis town to utilise as a landfill site would result in a similar loss of habitat and stream-flow disruption as the surface material is of similar depth.

Zone 2: This area falls between the first and fourth (last) ridge and is characterised by marble and dolerite ridges. Between the ridges are numerous larger drainage channels and washes in an east to west direction. These washes bear relatively dense fringes of perennial vegetation, with Acacia reficiens and Zygophyllum stapffii dominating. Colonies of Sarcocaulon marlothii (bushman's candle) are particularly abundant on the rocky plains between washes. See Biodiversity Specialist report – APPENDIX VI.

The availability of suitable fill material is primarily found in the washes and drainage lines. Five potential sites were identified within zone 2. See FIGURE 8.10. Of the five identified sites three sites were marked during the first assessment and were subsequently assessed by the Biodiversity and Archaeological specialists. The ridges between the washes are of similar nature as Zone 1 with approximately 30 – 50 cm of available material. The most abundant source of available and suitable material is to be found in the washes. See FIGURE 8.9.

FIGURE 8.9 – WASH - ZONE 2

It would therefore be unavoidable to excavate suitable material without doing so in the washes. Second assessment site 3 (See FIGURE 8.10) has the largest volume of available material that is approximately 1 – 1.5 meters deep and covers a large area of approximately 2 km^2 (depicted in FIGURE 8.9). The second assessment site 2 also has large volumes of available material and is also located in a system of washes. Excavation in the washes will result in loss of fauna & floras as well create a disruption in stream-flow with possible erosion implications.

Zone 3: The area determined as zone 3 is also described as the "northern plains" and is located north of the last ridge and ends at Trekkopje mine. The area is traversed by numerous braided channels and washes in an east west direction. As described in the Biodiversity Specialist study the plains between the washes tend to be relatively bare with sparse vegetation (ephemeral or multi-seasonal). However, it is here that the Biological Soil Crust (BSC) and Hypolithic Cyanobacteria (HLC) (Fenster Algae) are well developed, and lichen patches occur more frequently. Dried up mushrooms and ephemeral grasses are indicative of the productivity of these plains after rainfall. Occasional burst of productivity after rainfall provide crucial resources for populations of a high diversity of small animals on the plains (e.g. lizards, beetles, silverfish, spiders, scorpions, solifugids) for which the Namib is so famous.

The first assessment provided two possible borrow pit sites in zone 3 which subsequently have been advised against by the Biodiversity specialists (See Biodiversity Specialist Report Pg 29)

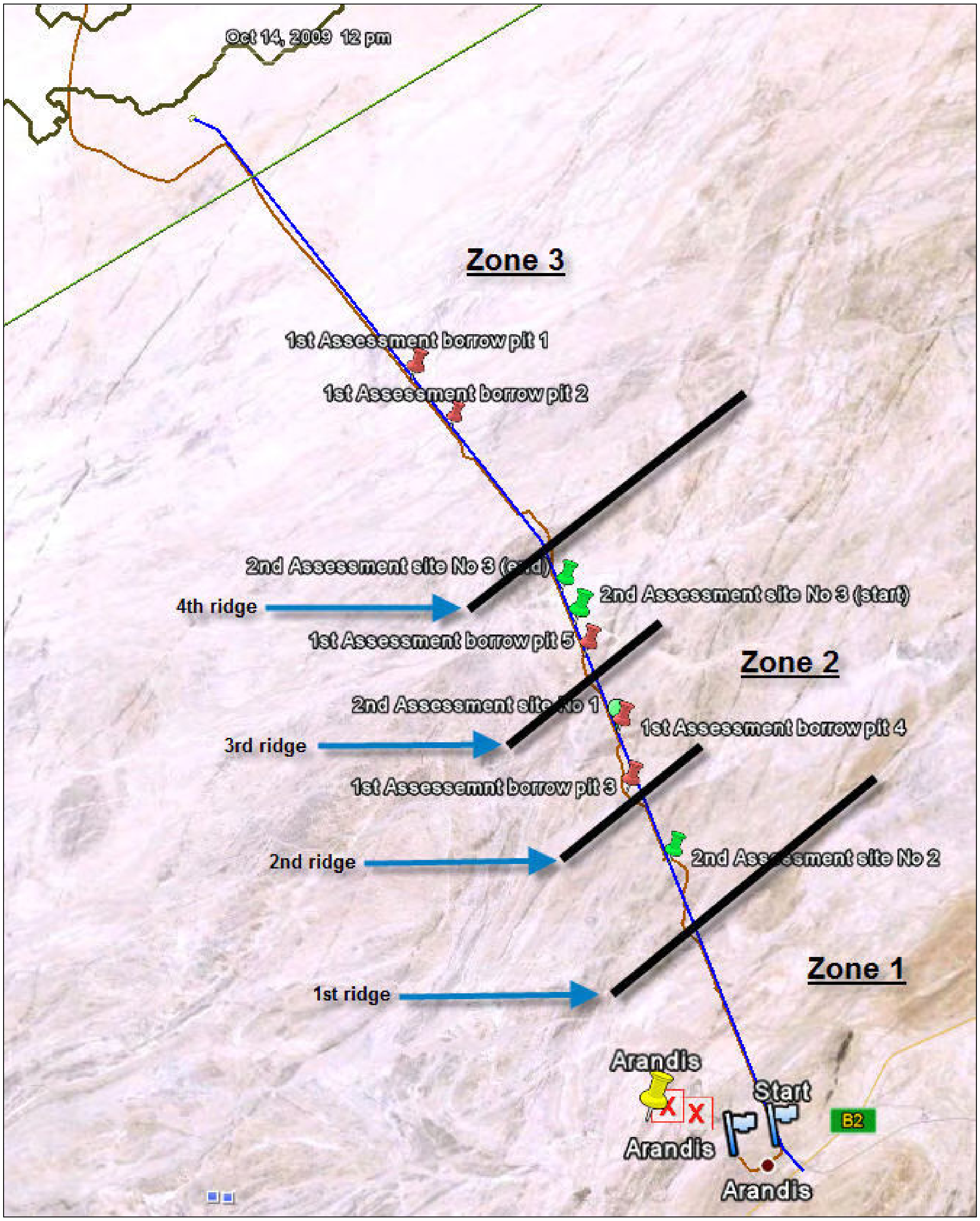


FIGURE 8.10 – ROAD ROUTE SHOWING ZONES & BORROW PIT SITES

8.8.2 Impact assessment

Borrow pit facilities can have substantial environmental impacts on soils, water, and the natural environment. Significant environmental problems can develop if these sites are not rehabilitated appropriately. Impacts range from chronic erosion, siltation, visual and aesthetic intrusion, air quality, and loss of habitat and stream-flow alteration.

Summary of mitigation measures

In bitumen road construction the requirement for fill material is unavoidable. The Trekkopje new access road will require approximately 608 000 m³ of various forms of fill material. An important consideration with regard to road construction is the cost of moving material. In most instances the shortest transport distances are most favourable from an operational and economic point of view. Ideally, borrow pits are created no more than 5 km apart so that the furthest transport distance is 2.5 km. However, the availability and suitability of material remains the most important criteria with regard to material source.

In all instances along the proposed routes (both current access road, and the proposed new road) borrow pits will dissect washes and drainage lines. It will not be possible to find suitable material sufficiently close to the route without disturbing washes and drainage lines. It is evident that the most suitable material is located inside washes and drainage channels. Zone 1 has suitable fill material available but of shallow depth which will require the excavation and clearing of large areas. Zone 2 has suitable and available material in washes up to 1.5 meters deep. Zone 3 has available material but also shallow in extent.

In terms of borrow material for the road two broad options are available:

<u>*Option 1(unmitigated option):*</u> Construct borrow pits at regular intervals along the route accessing where possible the required material. This option will be economically efficient as minimal transport of material will be required. However, environmentally it will be the most destructive option with the removal of large areas of vegetation and the disturbance of numerous washes and drainage channels. Rehabilitation will require substantial effort and cost to minimise the predicted impacts.

<u>*Option 2 (mitigated option):*</u> In order to provide material for zones 1 & 2 utilise the borrow pit areas identified in the second assessment. Potentially sufficient material is available for those sections of the road. This option will not be as economically efficient as material will have to be transported for some distance. However, environmentally it may be least destructive option in that possibly only two washes / drainage channels will be sacrificed as opposed to many in option one. Rehabilitation efforts would be concentrated to two areas as opposed to multiple areas. The material for the zone 3 section of the road to be sourced from mine overburden material. This will allow the ecologically sensitive northern plains to remain undisturbed by borrow pits.

- Placement of an adequate number of drainage culverts so as to avoid channelling of streams.
- Concrete dissipation structures designed to slow fast-running storm water thereby reducing its downstream erosive potential.
- Immediate rehabilitation and re-seeding of borrow pit areas.
- Shaping of borrow pits to reflect original topography.
- Maintain open channels and prevent blockage through loose material.
- No cut and fill using large V-sections through the ridges.

Principal direct impacts
In road construction, disturbance of the surface and the pre-road topography is unavoidable. Physical land disturbances would be limited to the road disturbance corridor. The disturbance consists of breaking up the surface area of the width of the road as well as the adjacent access road and turning areas and the excavation of borrow pits for fill material thereby altering its original state.
The most important impacts are:

- The loss of fauna and flora diversity
- Loss of habitats
- Fragmentation of the ecosystem
- Disruption of the hydrological system if washes are excavated.

Alteration of water courses will occur as a result of excavation, the placement of drainage structures such culverts, and the construction of the road embankment. Water courses allow for the distribution of seeds, provide food sources, availability and storage of water, accumulation of organic matter and provide habitat for fauna. Disturbance or alteration of the water courses present on the road route will negatively impact on the natural processes aligned to the system within the drainage basin. De-stabilising a water course has the net result that when it does carry water, the alteration facilitates a breakdown in the stability of the embankments, which leads to a breakdown and enlargement of the water course. Disturbance factors outside the water course result in a greater sediment load being placed, thereby impacting on the micro-habitat.

Indirect impacts
The disturbance of the land surface on the road reserve corridor may result in unstable soils, thereby increasing the potential for dust generation. Another indirect impact is loss and disturbance of habitat for fauna that require large ranges. The impact on fauna may be significant as the westward flowing dry washes are used as food-bearing corridors by animals crossing the desert, especially in dry conditions. The road route bisects a numerous washes.

Cumulative impacts

A number of mines (and potential mines) occur in the Erongo region such as Rössing Uranium, Marinica uranium Valencia uranium and Langer Heinrich. Smaller areas are highly impacted by granite quarrying activities of other operators on and adjacent to the Trekkopje tenement. In addition a number of prospecting activities are also taking place in the region. The possibility does exist that individual operations all will require unrelated access roads thereby increasing the potential cumulative impacts in the region.

Predicted impacts with no mitigation measures:

- Nature of the impact: The impact of borrow pits will be negative.
- Intensity: The impact is expected to be high, where the present natural processes will be altered to the extent that they temporarily or permanently cease. This will result in a deterioration of the impacted environment.
- Extent: The geographical extent of the loss of habitat, fragmentation, and stream-flow disruption will be local and primarily be limited to the Swakopmund / Arandis / Trekkopje area. The loss of fauna and flora diversity will be limited to the road disturbance corridor.
- Duration: The lifetime of the unmitigated impact will be long term. The impact will only cease after the operational life of the project and only through effective rehabilitation; and may extend well beyond the life of the project.
- Potential for mitigation/optimization: The impact is high and the potential for mitigation is high as the receiving environment has some mechanisms to mitigate or optimize the impact, as well as resources that can be called upon.
- Probability: The likelihood of the impact occurring is definite as the impacts created by borrow pits will occur regardless of any preventative measures.
- Significance: Is high to moderate – where for negative impacts the decision to proceed with the project should be with stringent mitigation measures. Mitigation measures are provided for in the EMP.
- Frequency of occurrence: The unmitigated impacts related to borrow pits will be continuous in nature until full rehabilitation has occurred.
- Phase: All phases - impacts without mitigation will occur during all project phases from construction to post closure.
- Degree of confidence in predictions: Certain – a statement of the degree of confidence in the predictions is based on the availability of information and the specialist's knowledge and expertise. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.

Predicted water quality & drainage impacts with mitigation measures in place

- *Nature of the impact*: The mitigated impact through the use of mine material and the excavation of only two borrow pits will also be negative but to a lesser extent.
- *Intensity*: The mitigated impacts are expected to be moderate to high. The impacts should still have effect on the natural, cultural and social functions and processes but in a modified way.
- *Extent*: The geographical extent of the loss of habitat, fragmentation, and stream-flow disruption will be local and limited to a few washes and drainage channels and will primarily be limited to the Trekkopje area. The loss of fauna and flora diversity will be limited to the road disturbance corridor.
- *Duration*: The lifetime of the mitigated impact is expected be medium term where the impact will coincide with the operational life of the project and the effective rehabilitation of the disturbance corridor.
- *Potential for mitigation/optimization*: The impact is moderate to high and the potential for mitigation is high as the receiving environment has some mechanisms to mitigate or optimize the impact, as well as resources that can be called upon.
- *Probability*: The likelihood of the impact occurring is definite as the impacts created by borrow pits will occur regardless of any preventative measures.
- *Significance:* Is determined as moderate– this impact will not be avoided unless mitigation measures are put in place and could require modification of the project design. However, the magnitude of the impact will be substantially less.
- *Frequency of occurrence*: The mitigated impacts related to borrow pits will be continuous in nature until full rehabilitation has occurred. However, rehabilitating fewer borrow pit areas will be substantially advantageous.
- *Phase:* All phases - impacts are assessed for their occurrence at particular phases of the project life-cycle and without mitigation these will occur during all project phases from construction to post closure.
- *Degree of confidence in predictions*: Certain – a statement of the degree of confidence in the predictions is based on the availability of information and the specialist's knowledge and expertise. A wealth of information and a sound understanding of the desert environment are available for the Trekkopje area.

Summary

Road construction inevitably requires the construction of borrow pits for fill material. Due to the availability of suitable material it is also inevitable that washes and drainage channels will be compromised on both alternative routes. The linear relationship of the various routes determines that the pipeline route (preferred option) will have the least number of borrow pits. The use of suitable and availabale mine overburden material provides an opportunity to further decrease the predicted impact on the environment through minimising the number of required borrow pits.

8.8.3 Pollution risk

Spillage from storage areas, re-fuelling tanks, bitumen mixing and storage and other road construction infrastructure may potentially lead to contamination of surface soils and water. Included in the risk is the possibility of chemical spillage during transport to and from the mine site. Pollutants can degrade habitat, disrupt biological processes, reduce biodiversity and reduce utility of landscapes.

Pollution risk arises from:

- Chemicals/reagents imported onto site.
- Seepage/spillage of sewage.
- Disposal of solid materials such as tyres.
- Deposition of fumes and exhaust gases from vehicles.

Chemicals to be transported to Trekkopje Mine:

The main chemicals to be transported to Trekkopje consist of reagents for ore processing, explosives and fuel. The expected quantities to be transported are as follows:

- Soda ash and sodium bicarbonate - rail: 1 train per day from Walvis Bay to the proposed Arandis road & rail siding terminal carrying up to 46 x 22 ton bulk powder ISO-veyors (gross), 7 days per week.
- Soda ash and sodium bicarbonate – road: up to 8 full and 8 empty road trains per day from the Arandis road & rail siding terminal to the Trekkopje mine site carrying up to 6 x 22 ton bulk powder ISO-veyors (gross), 7 days per week.
- Caustic soda liquid – rail: from Walvis Bay to the Arandis road & rail siding terminal carrying up to 7 x 32 ton bulk liquid ISO-tanks (nett), 7 days per week.
- Caustic soda – road: up to 4 full road trains per day from the Arandis road & rail siding terminal to the Trekkopje mine site carrying up to 2 x 32 ton bulk liquid ISO-tanks (nett), 7 days per week.
- 70% hydrogen peroxide liquid – road: by flat-bed road truck and trailer from Walvis Bay to the Trekkopje mine site carrying only 1 x 23 ton bulk liquid ISO-tank (nett), once every 8 days.
- 98% sulphuric acid liquid – road: by liquid bulk road tanker from Walvis Bay to the Trekkopje mine site carrying 32 tons load (nett), once every 6 days.

- 30% hydrochloric acid liquid – road: by bulk liquid road tanker from Johannesburg direct to the Trekkopje mine site carrying 32 tons load (nett), once a month.

Human health – toxicity and exposure potential

The reagents proposed for the Trekkopje project are bulk chemicals. Such chemicals present low hazard levels and are generally rated in the lower quartile of chemicals assessed for hazardous characteristics using the Indiana Relative Chemical Hazard Score (IRCH), developed by the Indiana Clean Manufacturing Technology and Safe Materials Institute (CMTI) at Purdue University in the USA (Pollution Information Scorecard, 2007). Notwithstanding this, there are a number of suspected (as opposed to recognised) health hazards associated with these chemicals. These hazards are listed in TABLE 8.9 below.

TABLE 8.9 – HEALTH HAZARDS ASSOCIATED WITH CHEMICALS PROPOSED FOR AT THE TREKKOPJE PROJECT[10]

Chemical	Suspected Health Hazard
Sodium carbonate	Gastrointestinal or liver toxicant Respiratory toxicant
Sodium bicarbonate	Gastrointestinal or liver toxicant Respiratory toxicant Kidney toxicant
Caustic soda	Respiratory toxicant Skin or sense organ toxicant
Hydrogen peroxide	Gastrointestinal or liver toxicant Respiratory toxicant Skin or sense organ toxicant Neurotoxicant
Sulphuric acid	Respiratory toxicant Skin or sense organ toxicant Musculoskeletal toxicant
Ammonium nitrate	Cardiovascular or blood toxicant

Environmental impacts associated with some of the chemicals proposed for use at Trekkopje are listed in TABLE 8.10.

[10] ***Data: Pollution Information Scorecard, 2007***

TABLE 8.10 – ENVIRONMENTAL IMPACTS ASSOCIATED WITH SELECTED CHEMICALS[11]	
Chemical	**Environmental Impact**
Sulphuric acid	Direct kills of fauna and flora if contact is made with concentrated spillages; water pH changes can affect biota and mobilise heavy metals
Caustic soda (sodium hydroxide)	Direct kills of fauna and flora if contact is made with concentrated spillages; water pH changes with direct or indirect effects
Ammonium nitrate	Fertiliser – can stimulate unwanted aquatic growth leading to eutrophication of water bodies
Fuels and lubricants	Direct kills of fauna and flora and smothering of communities in large quantities; bioaccumulation in some organisms; groundwater contamination from unidentified leaks

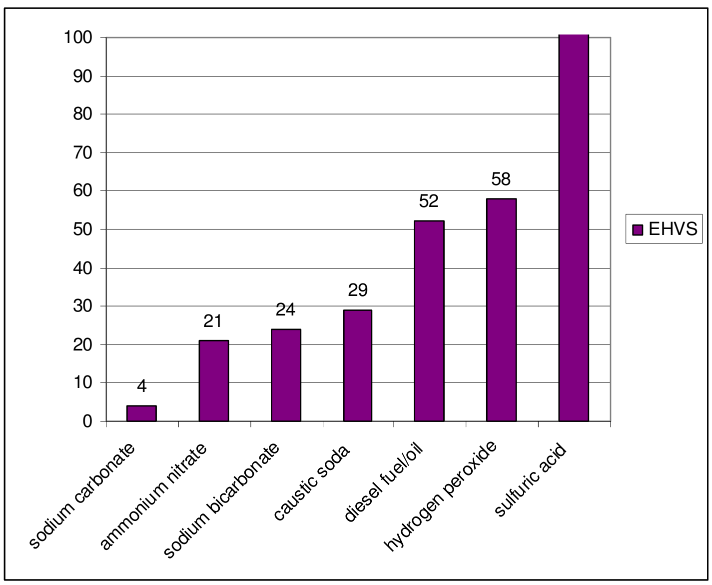


FIGURE 8.11 – ENVIRONMENTAL HAZARD VALUE SCORE (EHVS) FOR CHEMICALS PROPOSED FOR TREKKOPJE MINE[12]

Integrated environmental rankings – combined human and ecological scores

This indicator is based on toxicity and exposure considerations and integrates ecological and occupational human health impacts into a single statistic. The Total Hazard Value Score (THVS) combines the WEHS and the EVHS described above.

Total Hazard Value = [(1.15 x Worker Exposure Hazard Value) + (Environmental

[11] ***Environment Australia, 1997***
[12] ***Data: Pollution Information Scorecard, 2007***

Hazard Value/3.5)]/2

THVS values for the Trekkopje suite of chemicals are shown in FIGURE 8.12. Relative to all chemicals assessed in the USA using the IRCH system, three of the Trekkopje chemicals represent a low total hazard risk (in the lowest quartile), one a moderate hazard (25%-50%: diesel), one a high hazard risk (50%-75%: hydrogen peroxide) and one a very high risk (75%-90%: sulphuric acid) (Pollution Information Scorecard, 2007).

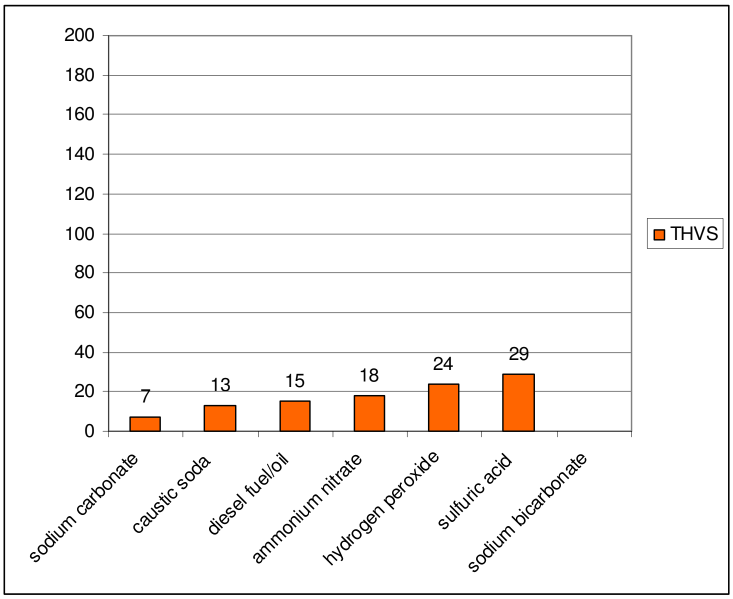


FIGURE 8.12 – TOTAL HAZARD VALUE SCORE (THVS) FOR CHEMICALS PROPOSED FOR TREKKOPJE MINE

On the basis of this assessment, the most hazardous chemicals are sulphuric acid, hydrogen peroxide and ammonium nitrate. Diesel is environmentally hazardous and appropriate pollution avoidance and mitigation measures, such as bunding and emergency response procedures, must be in place.

8.8.4 Impact assessment

Summary of mitigation measures

The presence and transport of chemicals carries an inherent risk. This risk extends to human health, environmental aspects. The following mitigation measures to be applied:

- Compliance with the chemical industry's RESPONSIBLE CARE Global Charter and associated lines.

- Effective emergency response plan
- Impermeable surfaces
- Effective management of storage areas
- Safe loading and off-loading conditions
- Good housekeeping

Direct impacts

The most important impacts due to possible chemical spills are:

- The loss of fauna and flora
- Impact on human health

Cumulative impacts

Slow and incremental accumulation of chemicals over an extended period continuously raises the risk pollution to communities and the biophysical environment in close proximity. The accumulation of diesel and oils on roads surfaces can lead to higher levels of ground water contamination.

Predicted impacts:

- *Nature of the impact*: The impact should it occur will be negative.
- *Intensity*: The impact is expected to be moderate, where natural processes and cultural and social functions continue, but in a modified way.
- *Extent:* The geographical extent of the impact will be local. The pollution from road surfaces will be limited to the road corridor.
- *Duration:* Long-term. The impact will only cease after the operational life of the project.
- *Potential for mitigation/optimization:* The impact is moderate, and the receiving environment has some mechanisms to mitigate or optimize the impact, as well as resources that can be called upon.
- *Probability*: Probable, there is a distinct possibility that the impact will occur.
- *Significance*: Low – this impact will be avoided with general mitigation measures. Mitigation measures are provided for in the EMP.
- *Frequency of occurrence*: Intermittent, occurring from time to time, without specific periodicity.
- *Phase*: construction, operation, and closure.
- *Degree of confidence in predictions:* Unsure – the occurrence of the impact is related to unknown management measures.

Summary

The transport and use of hazardous chemicals in most instances carries an inherent risk. However through effective management, the identification of the risks and an efficient emergency response plan the associated risks involved with the Trekkopje operation can be managed to pose a minimal threat to the environment and humans in the area.

8.9 Closure

International best practise requires that closure related issues be taken into project planning throughout the life of the mine and not simply relegated to the closure phase. Designing for closure is an important aspect in taking into account the associated residual and long term impacts. Closure related aspects with regard to the proposed new access are primarily related to the permanency of the road infrastructure. Of particular importance is the relationship between the closure of the road and that of the mine. At present the road is planned as a “dead-end” destination crossing over and ending on the mine tenement. Similarly the current access road effectively ends at the historical Annaberg Tin mines. At present project design does not take into account extending the road to any other link road or community in the area.

The relationship between the mine closure and road closure is important in that should the authorities decide to extend the proposed new road to link with the Henties Bay access road the road infrastructure and corridor will remain a permanent feature. The closure of the mine will therefore become important and should be designed to reflect the surrounding topography, address the related environmental impacts and to minimise the risks associated with large earthen excavations and their interaction with humans and the natural environmental components.

In this sense and taking into account unknown factors relating to possible new mines in the immediate that could make use of the new access road the recommendation is to remove the road corridor and rehabilitate the corridor to restore it the current state. However, on the implementation of future detailed mine closure planning the aspects related to the access road need to be taken into account as part of the detailed study.

9 SOCIAL IMPACT ASSESSMENT

9.1 Introduction

The social team made a clear distinction between change processes and impacts. Social impacts refer to the impacts that are actually experienced by humans on physical and/or cognitive level, whereas an impact variable is a change process that could lead to impacts. For example: an increase in population or the presence of strangers are not regarded as impacts, but rather change processes that lead to impacts such as a change in the perception about the nature of the community. Vanclay (2002) defines social impacts as:

"The consequences to human populations of any public or private actions (these include policies, programmes, plans and/or projects) that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally live and cope as members of society. These impacts are felt at various levels, including individual level, family or household level, community, organisation or society level. Some social impacts are felt by the body as physical reality, while other social impacts are perceptual or emotional."

Impacts are therefore the difference between the current and future development of the affected human environment with vis-à-vis without the project.

9.2 Approach and Methodology

Primary and secondary data collection methods were used. Primary data collection included the following:

- A field trip by motor vehicle along the various route alternatives during the week of 29 June – 2 July 2009;
- Personal interviews with the CEO of the Arandis Town Council (ATC), Ms Florida Husselman on 30 June 2009 and again on 2 July 2009;
- Observational study in Arandis on 30 June 2009; and
- Focus Group meetings with the following groups in Arandis:
    - Town councillors and education groups on 15 September 2009;
    - Business community on 15 September 2009;
    - Pensioners, NAMPOL and religious leaders on 16 September 2009; and
    - The Youth Council on 16 September 2009.

The secondary data collection mostly centred on a desktop study, in which the following documents were scrutinised:

- Project locality maps;
- Documents supplied by the ATC, including:
    - Hoadley, EM (2005). Arandis Socio-economic baseline study;
    - Arandis Sustainability Project Strategic Plan (2008-2012);

- Virtual Marketing (2008). Arandis Sustainability Project: Documentation Project Draft Report;
- Arandis Socio-Economic Baseline Study: Key points and Recommendations; and
- Cefe Training Network Namibia cc (2007). Report on Youth Skills Assessment and Profiling in Arandis.

➢ Existing project documentation generated through the public participation process (e.g. public meeting minutes, focus group meeting minutes, issues register, etc.); and
➢ The SIA Scoping Report.

Information that was relevant to the project was identified and assessed from these sources, within the context of the construction, operational, and decommissioning phases of the proposed project.

9.3 Regional Overview

The study area is located within the Erongo Region of Namibia. Erongo is one of 13 regions in Namibia and comprises an area of approximately 63,720km^2. To the west of the region lies the Atlantic Ocean, to the north the area is bordered by the Kunene region, the Otjozondjuba region to the east, and the Hardap region to the south.

The Population and Housing Census of 2001 indicated that the Erongo had a total population of approximately 107,663 people, of which more than half was male. The expected population growth rate was estimated at around 3.2% per annum. Assuming this growth rate was predicted correctly, the total population in 2009 could stand at approximately 138,517 people, which represents a total increase of 30,854 people over the 8-year period between 2001 and 2009 (at an average increase of approximately 3,857 people per annum).

In 2001, the majority of the population lived in urban areas (estimated at around 80% of the total population). Assuming that the estimated population size for 2009 is more or less correct, this would mean that the population density increased from 1.7 persons per km2 in 2001, to 2.2 persons per km2 in 2009. Close on two thirds of the total population are within the adult age range (between the ages of 15 and 59), which means that the majority of the population are within the working age category. In 2001, the employment rate of the region stood at approximately 66%. The majority of households had access to basic municipal services, such as water and electricity.

Erongo has been divided into six constituencies, namely Omaruru, Karibib, Brandberg, Arandis, Swakopmund and Walvis Bay. Arandis is the only constituency relevant to the current study.

9.4 Social Change Processes and Impact Assessment

A change process can be defined as change that takes place within the receiving environment as a result of a direct or indirect intervention. The expected impact follows as a result of the change process taking place. However, a change process can only result in an impact once it is experienced as such by an individual/community on a physical and/or cognitive level.

The change processes that were assessed in this SIA included the following:

- *Demographic processes:* changes in the number and composition of people;
- *Geographic processes:* changes in land use patterns;
- *Economic processes:* changes in the way in which people make a living and the economic activities in society;
- *Institutional and empowerment processes:* changes in the role, efficiency and operation of governments and other organisations, and people's ability to get involved and influence decision making processes;
- *Socio-cultural processes:* changes in the way in which humans behave, interact and relate to each other and their environment and the belief and value systems which guide these interactions; and
- Where applicable, health and safety changes and impacts were also assessed.

The SIA took into account the nature, intensity, duration, extent, phasing, probability of occurrence, and significance that a potential impact might have on the social environment. Furthermore, the SIA also considered the potential for mitigation, and confidence levels of the impact occurring. Impacts can be negative, neutral or positive.

9.4.1 Demographic Processes

Demographic processes relate to the characteristics of a population and include an overview of the population size and the composition of an affected community. In the case of the proposed Trekkopje mine access road, the closest centre of population is the town of Arandis. Currently the town itself is located approximately 1 km south-west of the turn-off onto the proposed access road, but with the town set to expand towards the proposed access road in future, it is expected that this distance will diminish, creating a real possibility that the proposed road could form an integral part of the town in future.

Baseline Demographic Profile

The baseline profile that was developed for the EIA on the Trekkopje Mine itself[13], estimated the total population of the town of Arandis at around 5,200 people – a number that was based on the polio vaccine campaign that was undertaken in 2005. According to the town councillors, the population size in 2009 is closer to 6,500 people[14]. It is commonly known that the town experienced a significant population outflow when the then largest employer in the area, Rössing Uranium, went into closure mode in the 1990s with a resultant high number of retrenchments at the mine.

More recently, it would appear that people are moving back to Arandis in the hope of securing employment at one of the many nearby mines (Rössing Uranium who extended their life of mine to 2016, the newly established Trekkopje mine, and Langer Heinrich). This situation resulted in a severe accommodation shortage. Since 2005, the waiting list for accommodation has steadily increased to approximately 260 people. This in turn gives rise to subletting of rooms in council houses and overcrowding within existing houses. Thus far, the Arandis Town Council (ATC) has been able to curb the formation of informal settlements.

Demographic Change Processes and Resultant Impacts

The demographic change process that are expected to arise, as a result of the construction of the proposed access road, are the influx of construction workers and the influx of unemployed job seekers

A total of approximately 250 people from various disciplines will form part of the construction team on the proposed access road. However, as some of these disciplines require unskilled labour, this segment of the construction team will be sourced from within the local area. At this stage, it is foreseen that as many as 150 construction workers (unskilled) could be sourced from within Arandis. In addition, the contractor would require approximately 20 skilled machinery operators, skills that might also be available locally. Theoretically, it might therefore be possible that a total of up to 170 locals could be employed over the 2-year contract period, which accounts for two-thirds of the construction team. The remaining 80 team members make up the professional/highly skilled portion of the team (e.g. project manager, engineers, or what is also referred to as 'senior management')

13 Chapter 7: Social & Cultural Baseline, Trekkopje Uranium Project Final ESIA Report, January 2008

14 The next official census in Namibia will be conducted in 2011 and therefore this number is unconfirmed (i.e. not supported by any official statistical data).

and, although they would most probably come from outside of Arandis, it is expected that they will commute to the construction site on a daily basis. It is believed that 80 commuters on a total population size estimated at around 6,500 people will not have a significant impact on the size and composition of the local community.

Any development creates with it the expectation of employment opportunities and with it comes the influx of unemployed job seekers. It is believed that Arandis is already experiencing the effect of job seekers returning home or entering the area for this first time, in the hope of securing a job at one of the surrounding mines. As news of the new access road construction spreads, this influx will increase. At this stage it is not possible to accurately predict the amount of job seekers that could potentially enter the area, as it could range from a single job seeker to hundreds. Unemployed job seekers normally focus their attention at the construction camp (which in this case will mostly house the site offices) or they might travel to the actual construction site(s).

An influx of job seekers can lead to an increased demand on local services and will not necessarily lead to a boost in the local economy, as these job seekers are mostly unemployed and therefore have no money to spend. The influx of job seekers might further lead to conflict with local residents in respect of competition over limited job opportunities.

Some of the people entering Arandis will fail to secure a job on the road construction team and may shift their focus to securing a job at one of the mines. This means that the job seekers may remain in Arandis indefinitely. To circumvent paying for services or rent, people may construct their own housing structures in an open area, opening up the possibility for more people to move into that same area, with the resultant formation and development of an informal settlement.

TABLE 9.1 – SUMMARY OF IMPACT: INFLUX OF JOB SEEKERS		
Criteria	**Without Mitigation**	**With Mitigation**
Nature	Negative	Neutral to Positive
Intensity	High	Moderate
Duration	Short	Short
Extent	Local	Local
Phase	Construction, possibly extending into Operation	Construction
Probability	Probable	Probable
Significance	Low	Low
Potential for Mitigation or Optimisation	Moderate	N/A
Confidence	Sure	Sure

9.4.2 Geographic Processes

Geographic processes relate to land use patterns and infrastructure in the area, where land use is defined as "... the human modification of the natural environment or wilderness into a built environment such as fields, pastures, and settlements." [15]

Baseline Geographic Profile

Arandis is a fairly small rural town, approximately 75 km north-east of Swakopmund. The town was established in the 1970s to house black mine workers from Rössing Uranium mine. Although Arandis was proclaimed as an independent town in 1994, under the governance of a town council as opposed to Rössing Uranium, the town still has the legacy of being a mining township, particularly as a result of the number of tin and uranium mines operating on its outskirts. No large-scale agricultural activities were observed in and around Arandis.

[15] www.wikipedia.org.za/wiki/Land_use.html

The ATC has taken ownership of most of the residential houses in Arandis which it rents out at an average of N$400 per month. The majority of the streets in Arandis are tarred and well maintained. Some infrastructure such as street lighting, recreational facilities and business amenities such as shops are still lacking but automatic teller machines (ATMs) have recently been installed close to the municipal offices. Prior to that, residents had to travel the 75 km to Swakopmund to do their banking. While there, they also did their shopping and conducted other business, resulting in an estimated revenue loss for the town of Arandis of close on N$ 9.3 million[16]. Due to the lack of shops offering various products and services, residents in Arandis still prefer to do business in Swakopmund.

Other amenities in town include three schools, a number of churches, sports fields, a tertiary education facility (NIMT), a few businesses such as a clothing factory, a small cemetery on the outskirts of town, and a hospital that had its status reduced to that of a state clinic. At the time of the study, there was no filling station in town, but one was planned for the end of 2009.

The town is an Export Processing Zone (EPZ), which are zones proclaimed by national government to promote industrial and commercial export. Usually an EPZ also offers incentives such as an exemption from certain taxes, tariffs and quotas in an attempt to attract new businesses and foreign investment. A railway line passes to the south of town with not only rail sidings but also a passenger station.
Arandis is set to expand in future. On a recent visit to the area (September 2009), site clearance had started to the east of the main road leading into Arandis for what appeared to be a shopping mall (according to the site notice). A number of residential developments are also at various stages of the planning and implementation process.

The current alignment of the proposed access road traverses through the area earmarked for all these developments mentioned above. The ATC has requested the project team to move the alignment further east and out of the development area. At present the road passes at a distance of approximately 670 m from the closest point of the town, but even more concerning is the fact that it passes at a distance of only 340 m from the hospital/state clinic. Construction noise and passing traffic during operation could very well have a noise impact on the hospital and be to the detriment of patients recovering in hospital. This impact would be reduced and possibly even negated the further away (eastwards) the road alignment

[16] CEO of the ATC, Ms Florida Husselman, personal communication – based on a study that was done in 2004.

moves from the hospital and town. FIGURE 9.1 below shows the current road alignment relative to existing and future land uses.

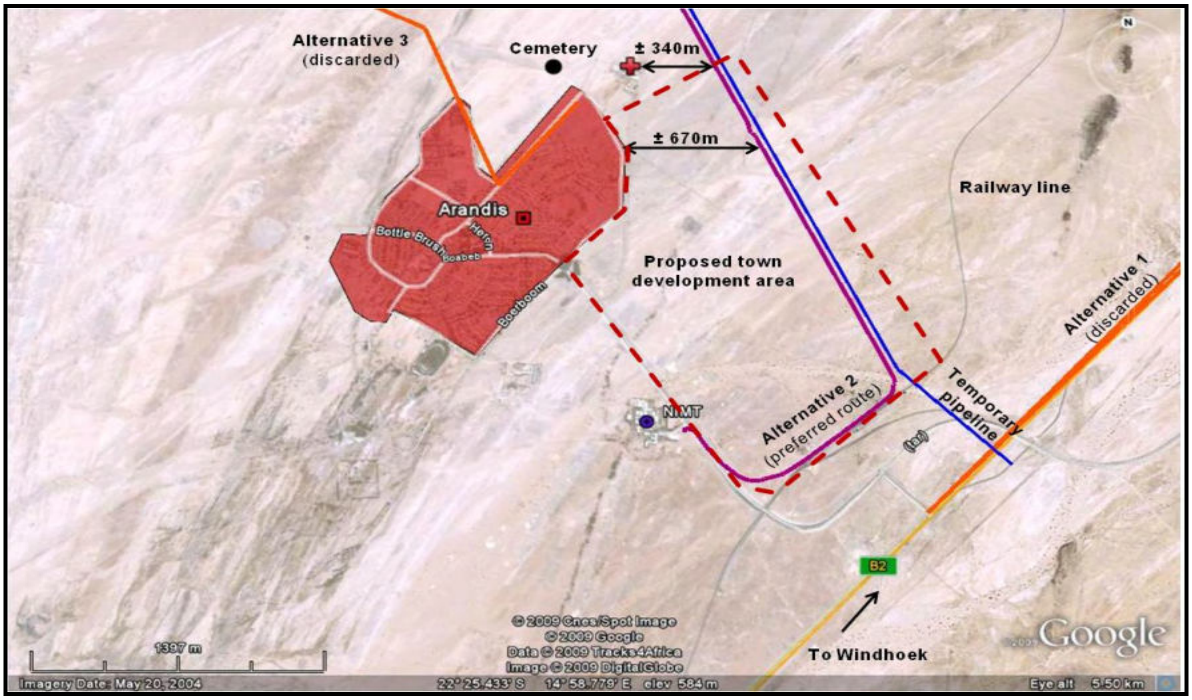


FIGURE 9.1 – ROAD ALIGNMENT RELATIVE TO CURRENT AND FUTURE LAND USES

Geographic Change Processes and Resultant Impacts

Potential geographic change processes from a social perspective have been considered within the context of changes in existing and future land uses and how such changes could influence or impact on the lives and behaviour of the local community. A land use change is often a gradual process and in the case of the proposed access road, it might create expectations or set a precedent for further land use changes. For example: the road opens up an area that was previously inaccessible and given the fact that the area is now a short and comfortable drive away, the area becomes more attractive to developers.

The geographic change processes that are expected include a change in access to resources that sustain livelihoods and changes in land acquisition and disposal, including availability of land.

The proposed access road will traverse the //Gaingu Conservancy that borders on the Namib-Naukluft National Park as well as the West Coast Recreation area. The conservancy contains important features such as the Spitzkoppe national monument area and the Rössing Mountain. As is the case with the Trekkopje mine, the access road will be located on communal land, which is under the traditional leadership of the !Oe#Gan Traditional Authority (TA). Under the auspices of the TA, community members have certain customary rights, which means that they have lifetime residential and farming rights within the boundaries of the conservancy, including seasonal grazing rights.

Previous environmental studies that were undertaken in the area (notably the EIAs for the Trekkopje mine, and the Desalination Plant) have noted that the land within the conservancy is not fitting for agricultural activities, but that it did have the potential to become a source of revenue for the local community if its tourism potential was unlocked. However, to realise the area's full tourism potential, a management plan has to be developed and implemented, which to date, has not been done.

In addition to these customary rights, community members who are registered members of the conservancy also have the right to manage and use wildlife in the area and have the exclusive right to develop and operate tourism initiatives within the conservancy. One such initiative is the Community Rest Camp at Spitzkoppe. At present Spitzkoppe is a mostly undisturbed environment and because of the natural beauty of the area coupled with numerous rock art paintings ('Bushmen paintings'), it is an area with high tourism potential. The question was therefore posed if it would be feasible to extend the access road to Spitzkoppe upon mine closure. At this stage it is virtually impossible to accurately predict how an area will grow and develop over a period of 20 years and therefore the decision was made not to make suggestions in terms of road use during the decommissioning phase (i.e. mine closure) apart from the fact that the environment (road and road reserve) must be rehabilitated to its original standard.

As previously mentioned the proposed access road will open up an area that was previously inaccessible to people from Arandis and, given the fact that the area is now a short and comfortable drive away, the area may become more attractive to developers. It is therefore possible that the road could set a precedent for land use change in the vicinity of Arandis from an open space to a built up area. However, land use changes are largely dependent on municipal planning and approval and in this instance, the area where the road starts out in Arandis has already been earmarked for development (see Figure 9.1).

The proposed mine access road lies in very close proximity to the Arandis community. It is AREVA's responsibility to ensure that this community should at the very least enjoy the same standard of living as before, and if at all possible, reap the benefits of the project beyond temporary job opportunities during the construction phase. Mutual planning between the ATC and AREVA could be beneficial to both parties. For example, seeing as the road is going to be access controlled, the placement of the boom gate or security office a couple of kilometres from the intersection with the main road would mean that the residents of Arandis would now have a tarred road to the railway station. Even if the alignment is moved further east as requested by the ATC, the section of the road that runs parallel to the railway line could potentially be incorporated into the residential developments planned for that area.

Because the majority of the road's length will be located on communal land, approval for its construction and operation has to be obtained from the Ministry of Lands' Division of Land Boards, Tenure and Advice who, under the Communal Land Act of 2002, are responsible for the overall administration of state land, including communal areas. The Ministry has also established Regional Land Boards throughout the country. These Land Boards are statutory bodies who act together with Traditional Authorities in the allocation and cancellation of land rights for customary utilisation as well as business purposes. The Division of Land Boards, Tenure and Advice will need to issue AREVA with a Permission to Occupy (PTO) Certificate before construction can begin.

TABLE 9.2 – SUMMARY OF IMPACT: A CHANGE IN LAND USE, IMPACTS ON LOCAL COMMUNITIES' ACCESS TO RESOURCES THAT SUSTAIN THEIR LIVELIHOODS AS PART OF LAND ACQUISITION AND DISPOSAL, INCLUDING AVAILABILITY OF LAND.		
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Nature	Negative	Neutral
Intensity	Moderate	Low
Duration	Medium term	Short term
Extent	Local	Local
Phase	Construction and Operation	Construction and Operation
Probability	Probable	Probable
Significance	Moderate	Low
Potential for Mitigation or Optimisation	Moderate	N/A
Confidence	Sure	Sure

9.4.3 Economic Processes

Economic processes relate to the way in which people make a living and the economic activities within that society. The employment status within a community gives an indication of the economic stability of such a community and also serves as an indicator of such a community's general well-being.

Baseline Economic Profile

The town of Arandis has to a large degree always been dependent on the mining industry. The town was established in the 1970s for the specific purpose of housing mine workers from the Rössing Uranium Mine and as such, the whole town was developed and maintained by the mine. Workers received free housing and services and where they had to pay for such services, fees were minimal. Unintentionally, this situation created a dependency on the mine. In the 1990s the mine retrenched a large part of its workforce due to mine closure. People started moving out of Arandis and in 1994 the town was handed over to the Namibian government, under the jurisdiction of the ATC. As a municipal body, the ATC had to charge municipal service fees and rent for housing. Residents who were used to paying the minimum rent (+/- N$ 5 per month), now had to pay up to N$ 400 rent per month. This had a huge impact on household income and expenditure trends.

According to the baseline profile for the Trekkopje Mine EIA, the economy of Arandis is still mostly reliant on the mining sector, particularly Rössing Uranium. In 2005, the employment rate in Arandis was estimated at around 64%. This is on par with the employment rate of the region. Recent developments in the mining industry, such as Rőssing extending their life-of-mine, and the construction of the new Trekkopje mine, have created additional employment opportunities. Given the skill constraints in Arandis, it is unclear whether or not the local residents have been able to make use of these opportunities. Although there are a number of community based industries located in and around town, these industries do not make a significant contribution to Arandis' economy and mine closure would have a detrimental effect on the town, with people leaving in droves. Therefore, to ensure the sustainability of the town and the diversification of its economic base, the ATC has implemented a Sustainable Development Project Strategic Plan (SDPSP). The economic objectives identified in the SDPSP include:

- "Arandis needs to institute incentive schemes to attract interested investors to Arandis to enable the establishment of a market that has sufficient supply and demand sustaining a continuous growth in Arandis"; and
- "Arandis needs to become self-sustainable by establishing a business community that is not only servicing the mining industry".

Arandis is ideally placed for industrial development. The town has a small airport approximately 6 km to the south of town, on the road to Windhoek and Walvis Bay, a railway line runs to the south of town, the area has good weather conditions and lies outside the rust belt, and the town has been awarded EPZ-status by national government. At present, despite these positive conditions and the ATC's efforts to diversify the town's economy base, residents and passersby prefer to spend their money outside of Arandis. About a third of the economically active population is unemployed. The relationship between unemployment and various other social ills includes poverty, negative shifts in self-esteem for affected individuals and their families, increased anxiety, stress, and associated increases in physical and mental illness, alcoholism, drug abuse, child abuse and family breakdown. Unemployment can also lead to an increase in racism, discrimination, suicide rates and crime rates. Alcohol abuse is seen as the biggest social ill in Arandis, according to its residents. Where people prefer to spend their money on alcohol instead of fulfilling their financial responsibilities, it creates a vicious circle where people become more indebted and creditors are unable to pay their service providers, which leads to a general, slow decay. The ATC hopes to change this situation by marketing the town as an alternative industrial town. If investors are drawn to the town, it would broaden the town's economic base, reduce the town's dependency on the mining industry, create additional job sources and ultimately stimulate the local economy to such an extent that people will prefer to spend their money in Arandis instead of further afield in the larger centres.

Economic Change Processes and Resultant Impacts

The economic change processes and resultant impacts that are expected to result from the proposed access road and the associated infrastructure are the enhancement/reinforcement of economic equities, a change in the employment equity of vulnerable groups and a change in occupational opportunities. For AREVA a shorter point-to-point access road means time and cost savings, not only for the mine itself in terms of its transportation of goods and services but also for its employees,

It is foreseen that the construction and, to a lesser extent, the operation and maintenance of the road will lead to enhanced economic opportunities in the form of 170 direct employment opportunities, which will be potentially reserved for local community members of Arandis. Contracts between developers and contractors normally stipulate employment requirements, which usually include gender quotas, youth quotas and quotas for local labour to be employed during the project. In addition, a certain proportion of time for which construction workers are paid could also be spent on skills development initiatives.

It is expected that salary packages will differ between skilled and unskilled work with the majority of the job opportunities calling for unskilled labour (+/- 150 positions). The unskilled labour positions will require no previous work experience on road construction or construction in general and therefore any local resident who is willing and able can apply for a position on the construction team, including historically vulnerable groups such as women.

The construction of the proposed access road can also lead to indirect employment opportunities, which can be either formal or informal. Indirect formal employment refers to direct employment by the contractor but not for the actual construction team, e.g. support staff such as messengers and personal assistants. Indirect informal employment mainly relates to entrepreneurial services that are not directly employed by the contractor or linked with the construction activities, e.g. domestic services, food stalls, etc. at either the construction camp or the construction site.

This indirect employment will create additional employment opportunities over and above the 150 - 170 direct formal employment positions.

One drawback of the project is that most of the employment opportunities created by the construction of the proposed road will be temporary, lasting only for the duration of the construction period (approximately 2 years). On completion, it is envisaged that only a handful of workers will be retained for operational and periodic maintenance work. Nevertheless, the fact that approximately 150 people will have acquired new skills and have gained 2 years' worth of experience, will partially offset this drawback. Although the employment opportunities will only be temporary, for its duration, the project will still bring much needed relief to the unemployed segment of the economically active population of Arandis.

TABLE 9.3 – SUMMARY OF IMPACT: THE CONSTRUCTION AND MAINTENANCE OF THE PROPOSED ACCESS ROAD WILL ENHANCE ECONOMIC EQUITIES; BRING ABOUT A CHANGE IN THE EMPLOYMENT EQUITY OF VULNERABLE GROUPS AND A CHANGE IN OCCUPATIONAL OPPORTUNITIES.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Nature	Positive	Positive
Intensity	Low	Moderate
Duration	Short term	Medium term
Extent	Local	Local
Phase	Construction and Operation	All phases
Probability	Definite	Definite
Significance	Moderate	High
Potential for Mitigation or Optimisation	High	N/A
Confidence	Sure	Sure

9.4.4 Institutional and Empowerment Processes

Institutional and Empowerment processes relate to the role, efficiency and operation of government sectors and other organisations within the area in terms of service delivery. It also investigates the ability of people to engage in decision-making processes to such an extent that they have an impact on the way in which decisions are made that concerns their immediate social environment.

Baseline Institutional Processes

Between 2005 and 2009 the waiting list for accommodation in Arandis grew from 150 people to 260 people. This indicates a large shortage of housing, which has resulted in overcrowding and the spread of informal settlements.

The water reticulation system in town was replaced at the end of 2005 and the existing waste water treatment plant can handle a maximum capacity load of up to 10,000 people. An informal landfill site is located to the southwest of town on an open plain, which causes the wind to blow waste all over the area. It has been suggested that one of the road construction borrow pits be rehabilitated into a formal landfill site for the town of Arandis.

The hospital in town used to be a state of the art medical facility, but in recent years has been downgraded to a state clinic. The clinic falls under the auspices of the Ministry of Health and Social Services and does not offer a 24-hour service or overnight facilities (although an after-hour emergency service is available). The clinic has a limited capacity to deal extensively with medical emergencies such as serious motor vehicle accidents. Doctors from surrounding areas, such as Swakopmund, work shifts at the clinic on a rotary basis during the week and patients with medical conditions that require hospitalisation, have to travel the 75 km to Swakopmund.

Apart from a police station, Arandis also does not have other emergency services such as an ambulance service, an emergency/trauma room, or fire and rescue services.

Baseline Empowerment Processes

In terms of baseline empowerment processes, the hierarchy of needs as set out by Maslow, offers insight in terms of people's potential level of involvement in the EIA process and the issues that might be pertinent to them in a development of this nature. Maslow argued that the type of need that a person experiences is dependent on the fulfilment of other needs. The needs are organised in a hierarchy, where each level of need has to be fulfilled before the next level of need can be experienced (refer to FIGURE 9.2).

In order for people to fully participate in a process that might affect their future, they need to be functioning on the level at which they experience a need for knowledge and understanding as well as the need for an environment that is aesthetically appealing. For a person to reach this level, their basic needs would need to have been met.

FIGURE 9.2 – MASLOW'S HIERARCHY OF NEEDS

This means that people who live in poverty because of high unemployment rates, low-income levels and a poor education are more focused on basic needs. People on this level would normally focus their attention on the more immediate benefits of a project such as job creation, irrespective of the negative and/or longer term impact that a development could have on their natural and/or human environment. People who are employed and more affluent will be less concerned with potential positive spin-offs such as job creation and more focused on how such a development would negatively affect their environment. People who are more focused on their basic needs are therefore in a sense disempowered to fully participate in the process. The issue here is not that these communities are misinformed or that they lack information as such, but rather that they are more ignorant about their rights and responsibilities as participants in the process. Because of the level on which they function, these residents may fail to comprehend the associated impacts (both negative and positive) that the proposed project would bring to their area. Their lack of understanding has bearing on future generations that will inhabit the area.

This is the case in Arandis. Although during a round of focus group meetings held in September 2009 none of the participants were ignorant or misinformed about the project, when asked what the local community of Arandis expected from this project, the unanimous answer was “jobs”. Even when the potential negative aspects were reiterated, the shorter-term positive impact of jobs and income generation seemed far more important to the participants, than the longer-term negative impacts.

Institutional and Empowerment Change Processes and Resultant Impacts

The institutional and empowerment change processes and impacts that are expected to result from the construction and operation of the proposed Trekkopje Mine access road include a change in community infrastructure, a change in housing needs/demands and the potential for social mobilisation or attitude formation against the project.

Additional municipal services (such as water, sewage and waste removal) will be required at the construction site(s) and the construction camp during the construction phase. The additional demand on municipal services is not a point of concern at this stage, as it appears from the baseline profile that the town of Arandis has sufficient capacity to supply additional municipal services. Although the ATC will be able provide these services, it is the contractor’s responsibility to install and remove the (temporary) infrastructure required to access these services.

The construction camp will only be used to house site offices, a workshop to undertake maintenance on construction machinery and a stores for material and machinery. To contain any spillage, hazardous materials like fuel tanks will be located in an enclosed area within the construction camp. The construction camp will be fully fenced and access controlled. Once the construction period has ended, the construction camp will be removed entirely and the area will be rehabilitated to its original standard. The change brought about by the construction camp to community infrastructure is therefore only temporary in nature, along with the infrastructure that was used to access municipal services such as water, electricity and sanitation.

It is important to note that the houses in Arandis do not have building foundations. This means that blasting activities in the area could potentially damage the houses in town, endangering the occupants’ safety. Reparation costs would have an economic impact.

The potential in-migration of a construction team consisting of approximately 250 people would severely exacerbate the existing situation of overcrowding and lack of accommodation in Arandis. However, it is estimated that between 150 and 170 people can be sourced from within the local community. As these people would already be resident in the area, no additional housing would be required. Therefore, it is vitally important the local labour be utilised. If all of the unskilled labour (150 positions) and most of the semi-skilled/skilled labour (20 positions) are sourced from Arandis, there will be no need for a resident construction camp.
The remainder of the construction team (+/- 80 people) will be made up of senior management, who will reside in Swakopmund. Estimates have shown that Swakopmund is experiencing a population growth rate of approximately 9% p/annum, mostly as a result of the numerous mining developments in the area. It is predicted, that at this growth rate the municipality may not be able to provide adequate land, housing, municipal services and healthcare facilities to cater for all of its residents. The influx of 80 people will not have a detrimental effect on the receiving environment, but it is important to take into account the cumulative impact that the influx of people from various developments could have on the area.

Depending on whether the road construction starts at the mine site or at Arandis, construction workers will have to be transported to site. This will in all likelihood be by bus. It is expected that the bus depot will be located in close proximity to the site office construction camp, the location of which must be determined in thorough consultation with the ATC.

If the use of a residential construction camp is unavoidable (that is to say that all avenues to secure local employment have been exhausted, resulting in a situation where labour has to be ‘imported’), it is recommended that such a camp be located at the mine. Failing that (due to possible safety and security risks), the camp should be located on the outer edges of Arandis with a final location decided upon in close consultation with the ATC and other key stakeholders.

An attitude is formed when people take on a specific issue, coupled with their past experiences associated with either the issue or with the way it has been dealt with by those responsible for creating the situation (in this case, AREVA). A person’s attitude towards a certain issue or situation can strongly influence the way in which that person views subsequent issues/situations of a similar nature. If local residents are unsupportive of either the proposed project of the project proponent, it could lead to social mobilization.

The risk for social mobilization greatly increases if the project proponent is perceived as distrustful, i.e. if they do not deliver on their undertakings. To ensure support for the project by the residents of Arandis and to reduce the risk of social mobilization, AREVA should at all times be seen to care about the residents of Arandis. Residents should believe that they will receive some tangible benefits from the project. The undertakings and mitigation/enhancement measures stipulated in the Environmental Management Plan (EMP) should be implemented effectively and with due diligence to show local residents and affected populations that their needs are being taken into account.

The community of Arandis are expecting that any job opportunities arising from the project will be afforded to them before they are advertised outside of the area. None of the residents or municipal officials consulted during the SIA process objected to the implementation of the project. The risk for social mobilization at this stage of the project is therefore regarded as low, but residents have campaigned against situations that they have disliked in the past. Where social mobilization does occur, it could not only severely delay the construction process, but also lead to intense situations of conflict that ultimately impact on social well being.

TABLE 9.4 – SUMMARY OF IMPACT: ACTIVITIES ASSOCIATED WITH THE CONSTRUCTION PROCESS COULD BRING ABOUT A CHANGE IN COMMUNITY INFRASTRUCTURE AND A CHANGE IN HOUSING NEEDS. SOCIAL MOBILIZATION CAN OCCUR IF THE LOCAL COMMUNITY OF ARANDIS IS DISREGARDED.		
CRITERIA	**WITHOUT MITIGATION**	**WITH MITIGATION**
Nature	Negative	Neutral
Intensity	High	Low
Duration	Short term	Short term
Extent	Local	Local
Phase	Construction, possible extending into Operation	Construction
Probability	Probable	Unlikely
Significance	Moderate	Low
Potential for Mitigation or Optimisation	Moderate	n/a
Confidence	Certain	Sure

9.4.5 Socio-cultural Processes

Socio-cultural processes relate to the way in which humans behave, interact and relate to each other and their environment, as well as the belief and value systems, which guide these interactions.

Baseline Socio-Cultural Profile

The town of Arandis was built in the early 1970s to house mine workers from Rössing Uranium Mine. Although the town was built in the apartheid era, when it was customary for men to work in the city, leaving their families behind, Rössing's approach was to build some 160 houses for mine workers and their families, which meant that workers were not separated from their families anymore. Right up until their closure in the early 1990s, the mine singlehandedly maintained the town, with residents having to pay very little for their houses and municipal services. Therefore, in 1994 when the town was handed over to the national government, most residents could not afford to pay the prescribed rent on their homes and municipal service fees for electricity, water and sanitation. This lack of funds from households placed pressure on the ATC, who had to keep paying their creditors for services (e.g. Namwater).

Arandis still feels the effects of the apartheid laws that placed restrictions on trading and retails activity in townships. To this day there is very little economic development or diversification in town, with the majority of residents travelling 75 km to Swakopmund, which was a traditional 'white area' allowing trade and retail activities.

The residents of Arandis are still divided in how they view the town today. While the older residents still refer to Arandis as a mining town, for the youth, the town's identity is not vested in the mine anymore. The ATC is hard at work through its SDPSP to ensure the self-reliance and sustainability of the town beyond the life of any mine in the area but one of the key problems hampering Arandis is the town's legacy, not only as a mining town but also as that of a township. For example, AREVA have opted to have their offices in Swakopmund rather than in Arandis and some residents would like to understand why this is the case.

When it comes to the people of Arandis, there is a definite sense of camaraderie, with a strong sense of place attachment. Most of the youth see their future in Arandis, revealing that while they might go and study elsewhere, they intend to return to town one day. It is fair to say that most people recognize each other and get along and that those who complain, complain about the same things. Most residents expressed great dissatisfaction with the number of shebeens in Arandis which they believe to be the cause of the increase in alcohol abuse that often ends in violence. People who run shebeens do so as a result of unemployment, as a way to either earn or substitute an income. In Arandis it seems that most of the people who frequent shebeens do so out of boredom. Although the town has many sporting venues, there is not much in the way of entertainment and recreational facilities. But, despite these complaints, the residents who formed part of the consultation process indicated that they do not intend relocating away from Arandis.

Socio-Cultural Change Processes and Resultant Impacts
Socio-cultural processes recount the way in which humans behave, interact and relate to each other and their environment. The socio-cultural change processes associated with the construction and operation of the proposed access road could alter the interactions and relationships of the people in Arandis by bringing about a change in the socio-cultural environment. The following changes processes are

expected; dissimilarity in social practices, alteration in family structure, conflict, safety and crime impacts and change in sense of place.

Dissimilarity in social practices refers to the different values, social standards and religious beliefs that might exist between a large group of newcomers to town (such as a construction team) and that of its residents. Conflict situations tend to arise when one group attempts to exert power over the other group or where different cultural values are not respected. Dissimilarity in social practices can often be found between the unskilled to semi-skilled workforce and the local community. However, if local labour is used during both the construction and operational phases, this change process is not likely to occur.

If the majority of the construction or maintenance team were to come from outside of Arandis, it is possible, that due to their unique situation, construction workers engage in behaviour that makes them vulnerable, such as risky sexual behaviour (e.g. unprotected sex) and destructive behaviour (e.g. alcohol abuse, damaging the environment). This can be explained by their migratory status. When people are separated from their homes, they are also distanced from traditional norms, prevailing cultural traditions and support systems that normally regulate behaviour within a stable community. If the construction workers were to establish temporary sexual relationships with members of the local community or if they were to engage in sexual relations with sex workers, then the spread of Sexually Transmitted Infections (STIs) and HIV can become a matter of great concern. Workers who become infected and move out of the area are likely to spread the STIs and HIV to people in other areas.

Apart from the obvious health implications, HIV infection in particular also has an economic impact, not only on the local area, but also within a regional and national context. On a macro scale, the economic impact involves direct and indirect costs, the loss of human capital and the natural system of developing a generation through the transference of knowledge and skills necessary for development. On a more micro scale, HIV/AIDS brings about a change in the traditional family structure, e.g. children-headed households where both parents have died.

Family structures can also be altered in cases where locals secure permanent employment with the contractor, which in turn might cause them to move out of the area to become part of a migrant workforce. Although it is highly unlikely that the presence of the road itself will threaten family cohesiveness, or impact on immediate or extended family networks, or the traditional roles played by members of the family, it is expected that the human element that forms part of the construction process could influence or alter family structures to some extent. Again, this is more likely if the majority of the construction team is not sourced from within the local community.

Conflict can occur within a community or between the community and the project proponent. In the case of the proposed mine access road, there was no apparent conflict within the local community or between the local community and the project proponent (AREVA). This situation is unlikely to change if local community members are employed on the construction team in an open and transparent manner.

There is a perception that if crime increases in an area where construction workers are present, the construction workers are to blame. In people who hold this perception, this is likely to induce a mental health impact of fear. In most cases the criminal activities are carried out by the job seekers who loiter at the site in search of employment and not the construction workers. The use of local labour can counteract the influx of job seekers, as it is unlikely that local community members will inform people outside of the area of the availability of jobs for which they are applying.

Sense of place goes hand in hand with place attachment, which is the sense of connectedness a person/community feels towards certain places. Place attachment may be evident at different geographic levels; site specific (e.g. a house, burial site, or tree where religious gatherings take place), area specific (e.g. a residential area), and/or physiographic specific (e.g. an attachment to the look and feel of an area). Sense of place is the integration of the character of a particular setting with the personal emotions, memories and cultural activities associated with it.

Residents appear to have a strong place attachment to Arandis. The majority of residents have lived in Arandis for most of their lives and even those who moved to the town in recent years did not seem keen to move out of the area. The residents of Arandis believe that they would not be able to replace their current lifestyle (which included aspects such as peacefulness, tranquillity, friendliness, neighbourliness, and bonds of friendship) elsewhere in the country.

The potential impact on socio-cultural behaviour and the related perception of environmental changes can have either a positive or a negative impact on sense of place (e.g. peace of mind vs. frustration/anger). The introduction of a new project to the area can be viewed as a positive impact if people perceive the project as a means of job creation (as is currently the case in Arandis), or as infrastructural and/or economic development that is not intrusive on people's lives and do not cause them immediate danger. Potential negative impacts include the visual impact and the resultant intrusion on sense of place, which does not seem to be a point of concern to the residents of Arandis.

TABLE 9.5 – SUMMARY OF IMPACT: THE CONSTRUCTION AND OPERATION OF THE PROPOSED ACCESS ROAD CAN ALTER HUMAN INTERACTIONS AND RELATIONSHIPS BY BRINGING ABOUT A CHANGE IN THE SOCIO-CULTURAL ENVIRONMENT.

CRITERIA	WITHOUT MITIGATION	WITH MITIGATION
Nature	Negative	Neutral to Positive
Intensity	High	Moderate
Duration	Short term	Short term
Extent	Local	Local
Phase	All phases	All phases
Probability	Probable	Probable
Significance	Moderate	Low
Potential for Mitigation or Optimisation	Moderate	n/a
Confidence	Sure	Sure

9.5 Conclusion and Recommendations

The construction phase is characterised by a number of negative social impacts, which is mainly due to the nature of the activities that take place during this phase. Although the expected social impacts associated with the construction phase are mostly negative across all the change processes, these impacts are for the most part only temporary in nature and as such, it is expected to only last over the construction period. There are also a number of positive impacts, which can be enhanced if managed effectively.

A huge benefit that the construction of the proposed access road can bring to the local community is that of employment, albeit on a temporary basis. The entire segment of unskilled labour (as many as 150 positions) can be sourced from within Arandis. In addition, it is entirely possible that other relevant skills are also available locally, such as the 20 skilled operators that is required. Theoretically, it is therefore achievable to employ up to 170 locals over the 2-year construction period. Apart from the obvious financial benefit brought about by employment, which quite often also extends to the individual's family and social network, it also improves a person's skills base and work experience, which in turn increases such an individual's future employment prospects.

The use of local labour, i.e. people who already reside in Arandis, will also circumvent further overcrowding in Arandis and additionally, negate other potential social impacts associated with the influx of construction workers and/or job seekers who are not from the area, by preventing conflict over scarce resources, or because of dissimilarities in social practices. It is also less likely to alter family structures, as the family will continue to function as a social unit without fear of outside intrusion or abandonment.

In spite of the numerous difficulties that the town of Arandis faced over the years, it is slowly but surely attaining its independence from Rössing Uranium Mine through a municipal-driven strategic development plan. This will ensure a town that is more self-reliant and sustainable, and less dependent on the surrounding mining industry that is in itself limited by life of mine.

The alignment of the proposed access road as it currently stands, falls within an area of Arandis that has been earmarked for development, which will consist mostly of residential extensions. Therefore, joint planning between the ATC, private developers and AREVA (or its appointed contractors) concerning road alignment and road use, might be mutually beneficial to all parties concerned as far as this area is concerned.
Overall, based on the conclusions and findings of this report, the construction and operation of the proposed access road does not pose any social impacts that is deemed irreversible, fatally flawed, or severely detrimental to the social environment. This finding is subject to the implementation of, and adherence to the identified mitigation measures as recommended for inclusion in the EMP. Further recommendations include:

- Employ local labour as far as possible, with the prerequisite that the contractor may only appoint local community members from Arandis for unskilled work.
- Source semi-skilled and skilled workers primarily from Arandis. If the required skills are not available in the immediate area, source workers from the Erongo region first, before considering workers from elsewhere in Namibia. Workers from neighbouring countries should only be considered once all possible recourses have failed.
- Prohibit the use of a residential construction camp.
- Undertake a joint planning session between AREVA (and/or its appointed contractor), the ATC and private developers to determine a mutually beneficial road alignment and future (partial) road use for the 'Arandis development area'.

- Consider undertaking another SIA closer to the decommissioning phase to determine a viable or most preferred end-use for the road.

10 PUBLIC PARTICIPATION PROCESS

Public participation is the cornerstone of the EIA process. The principles of The Environmental Management Act (Act No. 7 of 2007) and the Draft Procedures and Guidelines for Environmental Impact Assessment and Environmental Management Plans (No. 1 of 2008) govern many aspects of EIA's, including public participation. These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment, and ensuring the participation of all communities possibly affected by the project.

10.1 Description of the Process

The public participation process is designed to provide sufficient and accessible information to interested and affected parties (I&AP's) in an objective manner to assist them to:

- raise issues of concern and suggestions for enhanced benefits,
- contribute local knowledge and experience,
- verify that their issues have been captured,
- verify that their issues have been considered in the technical investigations and
- comment on the findings of the EIA.

The process for this EIA has included during the scoping phase of the project the identification of key stakeholders, various regulatory authorities, communities and the general public. A Background Information Document coupled with an invitation to register as an interested and affected party was mailed to the identified parties. Media adverts for the scoping phase were published in various newspapers announcing a public meeting at Arandis and the availability of the scoping report. Similarly media adverts have been placed announcing the EIA public meeting to discuss the Draft EIA report. Flyers for both the scoping and EIA phase were posted at strategic locations in Arandis to make the meeting known to as many townsfolk as possible.

The first public meeting was held on Wednesday 17th June at 18h00. A key stakeholders meeting was held at 9 am on the 17th June. The minutes of the stakeholder meeting (attendee list included) and the public meeting and can be found in Appendix II and Appendix III of the Scoping Report.

A second public meeting was held in Arandis on the Thursday 21st January 2010. The principle intention of this meeting was to provide the results of the environmental impact assessment process and to allow for comment and feedback. The attendance list, presentation, comments and response form and adverts announcing the meeting can be found in APPENDICES VIII to XI. Key stakeholders and registered I&AP's were contacted via e-mail and invited to respond to the documentation. The entire EIA document pack is available on the web site www.turgis.co.za.

10.2 Raising of Issues

The issues raised during the public process have been collated into an Issues Trail – Comments & Response and are provided as part of the final document.

10.3 Availability of the Report

This draft EIA report and final EIA report is available at the following locations:

- Swakopmund Library.
- Arandis Town Council.
- Swakopmund Town Council.
- Areva Head Office – Swakopmund.
- Turgis Consulting – www.turgis.co.za.

10.4 Public Review of this Report

The public has had three weeks to review the report.

11 CONCLUSION AND RECOMMENDATIONS

11.1 Biophysical

It is inevitable that road construction activities will impact on the biophysical environment. These impacts will principally be related to the loss of fauna and flora and the fragmentation of the desert habitat in the Erongo region. In order for these predicted impacts not to remain permanent the recommendation from a biophysical point of view is to remove the road on mine closure and rehabilitate the disturbance corridor to allow the habitat to return to its pre-mining state.

In order for the predicted water related impacts to be minimised it is imperative that an adequate number of culverts be designed into the alignment of the road. Adequate culverts will also allow for the continuous movement of fauna (and flora through streamflow activity) to continue relatively undisturbed.

Dust impacts will through sufficient application of water to working surfaces be minimised to that beyond nuisance value. A certain level of human impact may be experienced in Arandis; however with the general prevailing wind, impacts should be minimal. The adequate supply of water remains a potential constraint to effective dust management.

It is clearly evident that the new access road will have substantially less impacts related to vehicle emissions. It is becoming internationally accepted to accommodate these global impacts in to local project planning. The most important aspect to global impacts is the difficulty in mitigation once the impact has occurred and therefore the importance lies in preventing or minimising the impact at project level. The linear relationship between length of road and emissions makes the shorter route the optimal choice.

Road construction inevitably requires the construction of borrow pits for fill material. Due to the availability of suitable material it is also inevitable that in the Trekkopje area washes and drainage channels will be compromised on both alternative routes. Once again the linear relationship of the various routes determines that the pipeline route (preferred option) will have the least number of borrow pits and require the least fill material. The possible use of suitable mine overburden material provides an opportunity to further decrease the predicted impact on the environment through minimising the number of required borrow pits.

The transport and use of hazardous chemicals in most instances carries an inherent risk. However through effective management, the identification of the risks and an efficient emergency response plan the associated risks involved with the Trekkopje operation can be managed to pose a minimal threat to the environment and humans in the area.

From a biophysical perspective the current access road will experience additional impacts through the provision of power, water and infrastructural services to accommodate the project. In addition, the post closure use of such infrastructure will not offset the environmental impacts associated with them as there are at this stage no planned uses for them.

11.2 Socio-Economic

The possible economic benefit that Arandis will accrue through post Trekkopje use of the infrastructure associated with the road & rail terminal holds tremendous potential. The presence of the terminal at Arandis will possibly act as a catalyst for further development thereby enhancing economic opportunity for the community.

The construction phase of the project is characterised by a number of negative social impacts, mainly due to the nature of the activities that take place during this phase. However, these impacts are only temporary in nature, lasting over the construction period. There are in addition a number of positive impacts, which can be enhanced if managed effectively.

A huge benefit that the construction of the proposed access road can bring to the local community is that of employment, albeit on a temporary basis. The use of local labour, i.e. people who already reside in Arandis, will also circumvent further overcrowding in Arandis and additionally, negate other potential social impacts associated with the influx of construction workers, by preventing conflict over scarce resources, or because of dissimilarities in social practices.

Overall, based on the conclusions and findings of this report, the construction and operation of the proposed access road does not pose any social impacts that are deemed irreversible, fatally flawed, or severely detrimental to the social environment.

11.3 Assumptions & limitations

The most important limitation with regard to biophysical impacts is the availability of information on the suitability and quantity of fill material required for the road. A substantial amount of investigation is required that will entail the excavation of test trenches to determine depth and chemical composition of the local material. Only on the completion of such testing will the exact location and size of borrow pits be determined. The same applies for the suitability of mine overburden material. An additional variable with regard to this material is the possibility that it may contain radioactive material making it unsuitable for use.

The recommendation from the EIA is that the road is removed and the corridor rehabilitated. However regional circumstances at closure may have changed whereby additional mines may be able to make use of the road – these factors are unknown. It is known that prospecting activities are taking place north of Trekkopje.

Authority requirements in terms of regional planning are unknown and as such the possibility does exist that they may at the time of closure wish the road to remain open and be extended to additional arterial routes in the area.

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