

**BIODIVERSITY ASSESSMENT REPORT  
FOR THE PROPOSED ACCESS ROAD FROM  
ARANDIS TO TREKKOPJE MINE**

A contribution to the Environmental and Social Impact Assessment

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## EXECUTIVE SUMMARY

A high-level biodiversity assessment was conducted by Gobabeb Training and Research Centre to provide information that would support or otherwise the previous study which was conducted for construction of a permanent tar access road from Arandis to Trekkopje mine. The assessment was to address the gaps in information arising from the re-routing of the access road in certain locations off the original service corridor to traverse previously undisturbed areas.

The assessment aimed to identify how the proposed new mine road access will influence the local biodiversity communities, how the local communities will adapt to the new road, identify major concerns and formulate recommendations to mitigate impacts.

To achieve this, a desktop review of available literature on biodiversity assessment in the area including Trekkopje Mine EIA was conducted. A site visit was done on 23<sup>rd</sup> July 2009.

The results so far obtained indicate that road will be in an area of ecological concern that is home to species in the endemic to near endemic category with one lizard that awaits species description and related vulnerability categorization. Disturbance is unavoidable because of the nature of the road works. Poaching of wildlife and introduction of alien species remains of most concern through out the life of the road. Additionally, ecological restoration to present conditions is not possible.

In view of these results, we recommend that the project proponent implements the mitigation measures laid bare in this report. We also recommend that use of the existing, well-established road to the east be considered as the first option for a main road to the mine.

## **ABBREVIATIONS**

BSC	Biological Soil Crust
ESIA	Environment and Social Impact Assessment
GPS	Global Positioning System Receiver
HLC	Hypolithic Cyanobacteria (also called Fenster algae)
SDU	Sodium Diuranate

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# **1. INTRODUCTION**

Gobabeb Training and Research Centre was contracted by Turgis Mining Consultants to conduct a high level biodiversity assessment for a proposed 32km tarred road that would link Trekkopje Uranium mine and Arandis town. The proposal is to site the new road as close to the temporary pipeline as possible in order to remain within the current disturbed corridor. Construction of the road will require approximately 500 000 m<sup>3</sup> of fill material to be sourced from borrow pits which will be located about 10km apart along the proposed route. The road would be a private one with an operational life span of 12 years. After the 12 years, the road will be decommissioned, demolished and the disturbed corridor will be restored to some ecological function. The route passes through arid environments of the Namib Desert, particularly the #Gaingu Conservancy.

The desert environments are typically sensitive to disturbance and require long times to recovery. There are many endemic species present in the area, thus a proper assessment of the sensitive ecosystems through which the proposed road will be constructed is presented by this study. The civil engineers have identified 5 borrow pit sites that are potentially suitable for excavation to supply fill material.

## **1.1. SCOPE OF WORK**

An environmental assessment of the access road along the current temporary pipeline route and the deviations as they occur at the ridges is required. The scope of work requires an assessment of identified sensitive sites and proposed borrow pit sites (as per waypoints provided by the engineers) along and near the proposed route. The assessment includes the listing of flora and fauna along the route and how the road will affect the movement of wildlife, resources flow at drainages/washes in the area. No alternative route was to be assessed, but the final decision by the mine should compare the proposed road with the existing well-established road located further east.

## **1.2. METHODS**

The methods followed for the collection of biodiversity data for this study were mainly the fieldwork method and desktop study. The fieldwork was conducted on 23 July 2009 while the desktop study, which was mainly the review of relevant literature, was a continuous process. The team comprised Dr Joh Henschel, Executive Director of the Gobabeb Training and Research Centre (P.O.Box 953, Walvis Bay, Namibia), Ms Taimi Kapalanga, Research Technician at Gobabeb, Dr Margaret Sikwese, currently fellow of the Southern African Institute of Environmental Assessment (SAIEA; lecturer at Bunda College of Agriculture, University of Malawi, P.O. Box 219, Lilongwe, Malawi), and Mr Paradzayi Tagwireyi, currently fellow of SAIEA (lecturer at Department of Geography and Environmental Science University of Zimbabwe, Box MP 167, Mt Pleasant, Harare, Zimbabwe).

### 1.2.1. The Sample

A team of 4 scientists conducted eight hours of fieldwork along the proposed route to gather data for this study. Hand held GPS receivers were used to identify waypoints that were provided by the engineers. Appendix 1 summarizes the 23 waypoints on which observations were made. The waypoints were representative enough for a generalized description of the biological environment but not good enough to map habitats because we followed a linear distribution. Figure 1.1 shows the linearity of the distribution of waypoints. The existing road that goes southwards from the eastern tip of the Trekkopje mining license area to Trekkopje railway siding was also examined, but no detailed assessment was made.

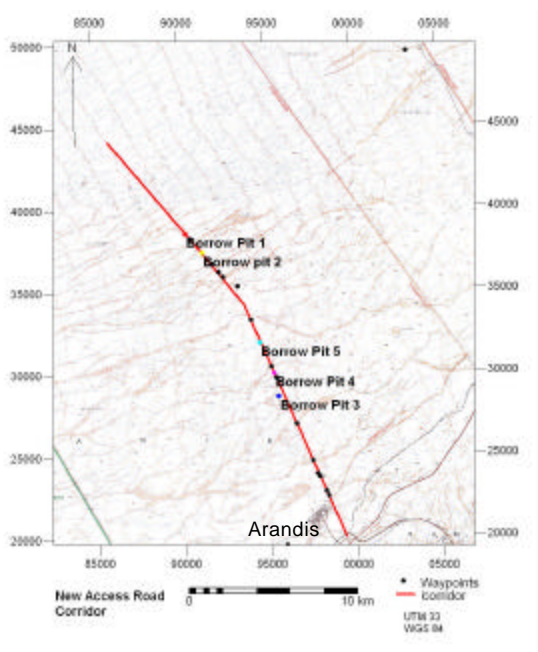


Figure 1.1 Linearity of the distribution of waypoints (adapted from Limptlaw, 2009).

### 1.2.2 Identification of species

We observed and noted the flora and fauna present within a radius of 100 meters of each way point. With regards to fauna, we did not only note presence, as in direct observation of creatures, but also evidence of presence such as dung, spoor, burrows, and nests. Plate 1.1 shows dung that gave evidence of presence of species not observed during the field trip. The dung is presumed to come from a chameleon, and in it one can see insect remains.



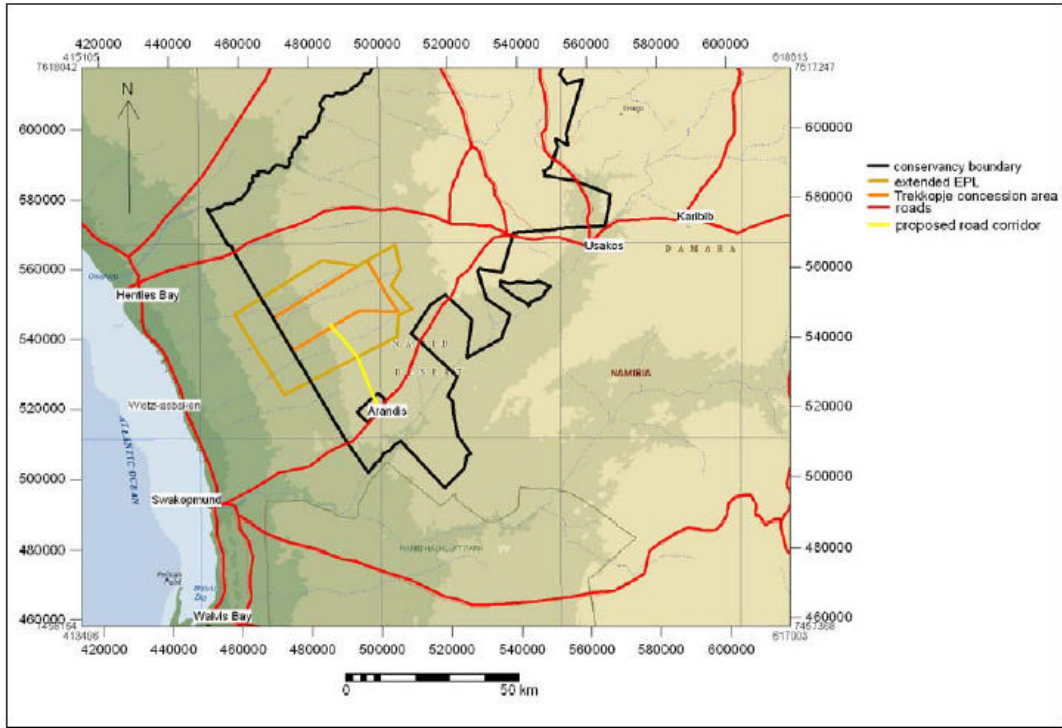
**Plate 1.1: Chameleon's dung composed of remains of other animals present but not observed in the study (waypoint 567)**

The naming of the species depended on expert judgment. Where it was doubtful to name the species, leaf specimens or pictures were collected for identification and naming at Gobabeb.

## **2. DESCRIPTION OF THE PROPOSED ROUTE**

### **2.1 Regional setting of the route**

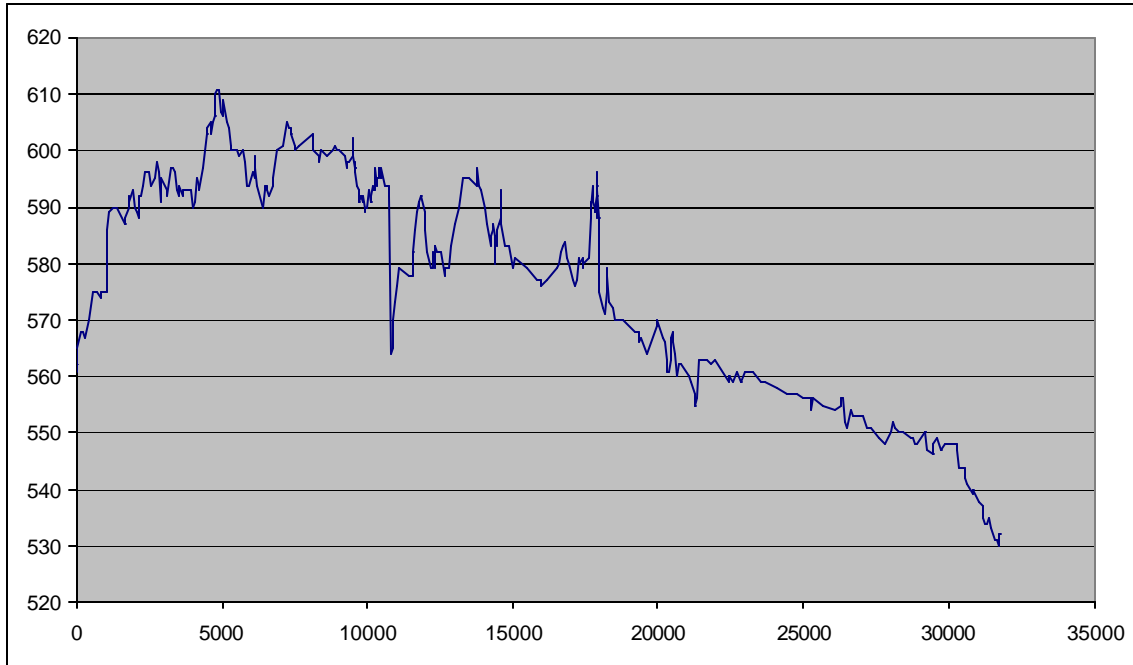
The 32km proposed route lies adjacently on the western side of the temporary water pipeline. It proceeds due north-east of Arandis through the #Gaingu Conservancy to Trekkopjie Uranium Mine. Figure 2.1 shows the regional location of the proposed road route. If the route was to be a straight line, it would be only 27km but the winding to avoid difficult terrain adds the extra 5 km to make it a 32km route.



**Figure 2.1: Location of the proposed Trekkopje access road**

## 2.2 Topography of the route

The route crosses uneven terrain across ranges of marble and dolerite ridges of varying elevation and size and numerous large to small washes in shallow valleys. The combination of valleys and ridges produces a continuous undulating landscape upon which the route cuts across. Additionally the route cuts across the wash ridge landscape at right angles. Figure 2.2 shows a model of the terrain from Arandis to Trekkopje.



**Figure 2.2: Terrain profile (meters above mean sea level) of the proposed road from the Arandis (left, 0m) to Trekkopje (right, 32000m) recorded with a GPS on 23 July 2009.**

### **2.3 Implications of the terrain to construction**

In order to produce a road terrain profile suitable to mine vehicle use, the cutting through ridges appears to be unavoidable. There are however many plant species resident on the ridges which makes the ridges ecologically sensitive areas. Furthermore restoration at decommissioning will be more difficult for incised ridges. These are some of the reasons why this study recommends the road to avoid ridges rather than cut across ridges.

### **2.4 Zonation of the disturbed corridor**

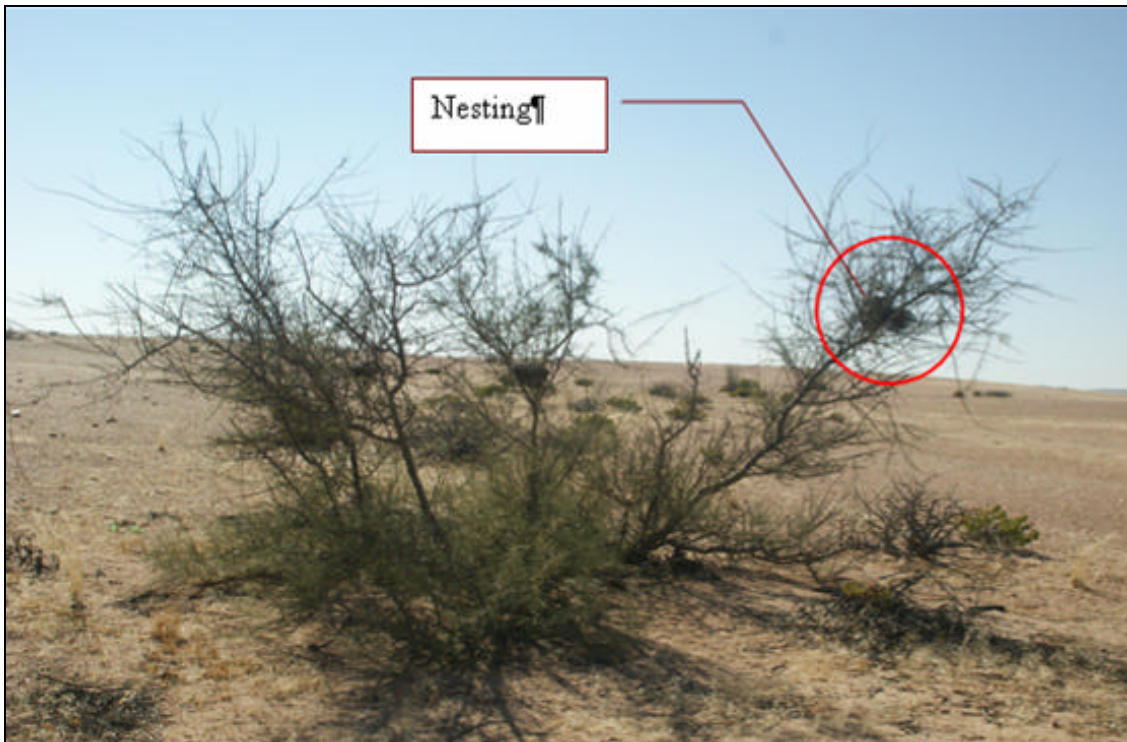
We observed that in addition to the ridge and washes landscape, the corridor can be zoned into northern and southern plains that have distinct vegetation characteristics. We zoned the landscape into; northern ridges, northern washes, southern ridges and southern washes

#### **2.4.1 The northern washes**

The washes are extensive and close network of broad ephemeral water channels with gravel and sand deposits plains that are colonized by perennial and annual species of plants, sometimes in high densities. The disturbed road corridor will cut through these fields and bulldozing of many individual and clusters of plants

is inescapable. These are often decades to centuries old and rehabilitation of the route will be difficult.

The washes contain a few trees namely (*Acacia erioloba*, *Acacia reficiens*, *Lycium tetrandum*, *Euclea pseudebenus*, *Salvadora persica*) that are obvious resources for many animals, such as birds nesting, mammals feeding or shading, and insects feeding and sheltering. The rare lappet faced vulture is crucially dependent on the isolated trees for nesting without disturbance. Plate 2.1 shows an isolated *Acacia reficiens* within a northern wash. Nesting is visible on the tree's branches.



**Plate 2.1 *Acacia reficiens* within a northern wash with bird nest**

Large vertebrates access these washes too. During the fieldwork, springbok were observed and other evidence showed that springbok utilize these washes for their movements along an east to west axis. Signs indicated that other large animals, such as gemsbok and ostrich, forage in the washes. The unavoidable fragmentation of these washes by the road has serious implications for human wildlife conflicts in the form of road kills.

A relatively high abundance of insects occurs in these washes. Bees are abundant and a potential risk to people (e.g. construction or maintenance crews) when the bees come to collect water (from drinking vessels or sweat). These bee populations are crucial for the pollination of the rich vegetation in the washes and the bees must not be destroyed to protect people.

### 2.4.2 Northern Plains

The plains between the washes tend to be relatively bare (Plate 2.2), with only occasional minor drainage lines and sparse vegetation (ephemeral or multi-seasonal). However, it is here that the BSC and HLC 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. For instance, based on taxonomic literature, we expect some 60 species of tenebrionid beetles to occur in the vicinity of Trekkopje. While rainfall drives their population explosions, detritus, lichen and hypolithic cyanobacteria (HLC, Fensteralgae, occurring under quartz) sustain them through the lean years.

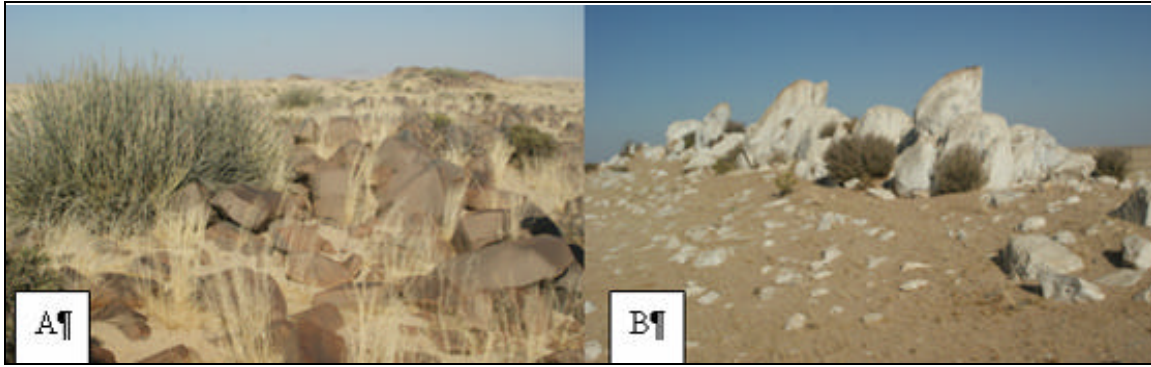


**Plate 2.2: Deceivingly bare northern gravel plains (A), with very well-developed biological soil crust on the Desert Pavement.**

The gravel plains (Plate 2.2) are patchily vegetated and have a very well developed biological soil crust, which provides resources to populations of fauna of various sizes. Such habitats have an average age of 500 years. If disturbed, recovery may take hundreds of years to occur. Besides the long-term physical damage (and negative aesthetic effects), disturbance severely changes natural soil processes and reduces productivity.

### 2.4.3 Southern Ridges

In the southern zone the route negotiates across or in close proximity to marble and dolerite ridges. We observed that vegetation communities of ridges differ significantly from their surroundings (Plate 2.3). The common species observed include *Stipagrostis ciliata*; *Zygophyllum stapfii*; *Commiphora saxicola*; *Aloe asperifolia*; *Paksonia africana*; *Stipagrostis gonatostachys*. Plate 2.3 shows vegetated marble and dolerite ridges.



**Plate 2.3 Vegetated ridges. A (dolerite) B (marble)**

These ridges do not have well-developed soils and the biological soil crust (BSC) and hypolithic cyanobacteria (HLC) are sparse, albeit present, particularly where there are quartz outcrops. Lichen cover is patchy and light on top of the ridges, absent or very sparse on the slopes. This implies that the biological impact of tracks is not so severe at the soil level. However, the physical structure of substratum, especially where it is loamy, is easily transformed to loose dust, which is susceptible to wind erosion in dust storms. The risk of dust cover on plants is high.

#### **2.4.4 Southern washes**

Between the ridges there is a network of drainage lines or washes running east to west. These are relatively narrow (compared to the northern zone) and most have sandy channels, with the remainder having rocky and stony channels. 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 and in one case an extensive, dense field about 100 m wide and over 1 km long (in east-west direction) was crossed (S22.34905 E14.95957). The washes show evidence of flooding during the past rain season Plate 2.4).



**Plate 2.4: Southern wash section showing evidence of previous floods**

We also observed that washes are used intensively by vertebrates, invertebrates and birds alike. Evidence of springbok, ostrich, aardvark, chameleon, long horned crickets, solifugid, korhaan, and black backed jackal were present. Cape hare, chameleon, horned adder, antlion, solifugid (*Hexisopus*), stone hopper, harvester ants (*Messor* sp), and a variety of tenebrionids, sand lizards (*Pedioplanis breviceps* and *Pedioplanis* nov.sp.), skinks (*Trachylepis*) locusts and Namib day geckos (*Rhaptropus* sp) were actually observed (Plate 2.5). One sand lizard that was seen and photographed on a gravel hill next to a dolerite ridge (Plate 2.6) is of special conservation significance, namely the northern plains lizard, which is an unnamed species, subject to taxonomic description (William Branch and Werner Conradie, pers.comm.).



**Plate 2.5: Some of the animal species observed in southern washes and plains, from left to right, top to bottom: horned adder, chameleon, short-headed lizard juvenile, Namaqua dove, short-headed lizard juvenile, pamphagid stone hopper.**



**Plate 2.6: Northern Plains Sand Lizard *Pedioplanis cf. inornata* (nov.sp.), a new species of lizard found around dolerite ridges and adjacent gravel slopes along the southern part of the proposed new road.**

### **3. Assessment of Impacts**

The impacts of the access road have been subdivided into three major categories according to the phases of the road: Planning and design, Construction, Operation and Decommissioning.

#### **3.1 Description and mitigation of impacts during the planning and design phase**

The planning and designing of the road has to take into consideration the presence of various flora and fauna identified in this report, as well as the topography of the area. As indicated earlier, the road traverses undulating landscape comprising of ridges and washes in the southern zone and plains and washes in the northern zone. In the design and planning phase, the impacts are mainly secondary or tertiary, except for the surveying part. This is because this phase involves decision-making and the impacts will occur only if the mitigation actions are not taken into account.

It is therefore important to note the impacts that will affect the southerly zones' ridges and rocky outcrops of marble and dolerite where, as discussed above, there is bound to be higher flora diversity and also habitat for other species of fauna of high importance. There is also a high possibility of soil erosion due to poor road alignment.

The northerly zone is largely washes and plains with high occurrence of the dollar bush and the bushman's candle. The impacts of high significance include loss of endemic and near endemic flora and fauna, as well as ecosystem disruption, fragmentation and elimination. These impacts (Table 3.1) need careful consideration by the designers of the road so that they are minimized by following the mitigation measures described in the Table 3.2.

**Table 3.1 Description of impacts at the design phase**

<b>Main activity</b>	<b>Impacts</b>	<b>Nature</b>	<b>Intensity</b>	<b>Duration</b>	<b>Extent</b>	<b>Significance</b>
Road corridor selection	- Loss of endemic and near endemic flora	Negative	<b>M</b>	<b>LT</b>	<b>LIM</b>	<b>M</b>
	- opening up of previously inaccessible or marginally accessible areas		<b>H</b>	<b>LT</b>	<b>L</b>	<b>H</b>
	- cutting of important ridges: loss of habitat		<b>M</b>	<b>LT</b>	<b>LIM</b>	<b>M</b>
	- Blocking migration corridor for fauna		<b>M</b>	<b>LT</b>	<b>L</b>	<b>M</b>
Road alignment	- ecosystem disruption, fragmentation and elimination	Negative	<b>H</b>	<b>LT</b>	<b>L</b>	<b>M</b>
	- soil erosion and loss of habitat	Negative	<b>H</b>	<b>LT</b>	<b>L</b>	<b>H</b>
Surveying	- Loss of endemic and near endemic flora	Negative	<b>M</b>	<b>ST</b>	<b>LIM</b>	<b>L</b>
Identification of suitable sources of construction materials (borrow pits)	- Loss of endemic and near endemic flora and fauna	Negative	<b>H</b>	<b>LT</b>	<b>L</b>	<b>H</b>
	- ecosystem disruption, fragmentation and elimination		<b>H</b>	<b>LT</b>	<b>L</b>	<b>H</b>

**Intensity:** (H=High; M=Moderate; L=Low); **Duration:** (LT=Long term; MT=Medium term; ST=Short term; PT=Permanent); **Extent:** (LIM=Limited to site; L=Local<2km; R=Regional/provincial; N=National); **Significance:** (H=High; M=Medium; L=Low; VL=Very low; N=Neutral)

**Table 3.2 Mitigation of impacts at the design and planning phase**

Main activity	Impacts	Mitigation measure	Impact level before mitigation	Impact level after mitigation
Road site selection and alignment	Loss of endemic and near endemic species Disturbance of important ridges Habitat fragmentation	Locate route on less sensitive sites Road should not be fenced	H	L
Surveying	Loss of endemic and near endemic species Poaching of wildlife Opening up of previously inaccessible areas	Avoid off-road driving at all cost Prohibit the use of resources such as honey, game, fuel wood.	H	L
Exploration for road fill material (borrow pits)	Loss of endemic to near endemic species Habitat loss and fragmentation	Prohibit off road driving Avoid ecologically sensitive areas described	H	L

**H – high; M – medium; L - Low**

### **3.2 Impacts during Road Construction**

During the construction of the road, there are a number of activities and their associated impacts as shown in the Table 3.3. Of high significance is the loss of endemic and near endemic flora and fauna due to clearance of vegetation. The dust as well as the fumes generated by the movement of vehicles during clearing of the areas, grading and topsoil removal are also of concern as they may pollute the flora and fauna in the area.

The southerly zone of the road, because of the ridges and washes, is very likely to be impacted by loss of flora and fauna, if mitigation is not implemented.

As for the northerly zone, the washes are more populated with flora than the plains. However, the plains showed more signs of them being inhabited by gerbils. In addition, the washes are very likely to be migration routes of fauna and these will be disrupted by the road construction activities. In this case, construction of culverts on the washes to raise the road will have a positive impact which is of medium significance. This positive impact can be enhanced by following the mitigation plans as outlined in Table 3.4.

Construction of the road will require that a constructor's camp is erected somewhere along the road. At the time of this assessment, there was no information as to the exact location of the camp. To this end, the impacts that the constructor's camp may have on the biodiversity of the area are of a general nature and not specific to any particular zone. Those responsible for the construction should consider the descriptions of the zones provided above and make the decisions on location. We recommend that there be no camping along the route to minimize the crime of poaching. The construction camp can be located at the town of Arandis since the distances are reasonably short.

**Table 3.3 Description of impacts at the construction phase**

<b>Main activity</b>	<b>Impacts</b>	<b>Nature</b>	<b>Intensity</b>	<b>Duration</b>	<b>Extent</b>	<b>Significance</b>
Vegetation clearance along the route	- loss of endemic and near endemic species	Negative	H	LT	L	H
	- loss of habitat	Negative	H	LT	L	H
Topsoil removal and storage	- dust smothered flora and fauna	Negative	H	LT	L	H
	- loss of habitat	Negative	H	MT	L	M
	- loss of flora and fauna	Negative	H	MT	L	M
Blasting of cuttings	- loss of habitat	Negative	H	MT	LIM	M
	- ecosystem fragmentation	Negative	H	MT	LIM	M
Excess spoil disposal	- loss of habitat	Negative	M	MT	LIM	M
Grading	- dust smothered flora and fauna	Negative	M	ST	LIM	L
	- loss of fauna through road kills	Negative	M	ST	L	M
Earthmoving	- dust smothered flora and fauna	Negative	M	ST	LIM	L
	- loss of fauna through road kills	Negative	M	ST	L	M
Laying of base course and sub-base layers	- loss of flora and fauna from pollution from chemicals	Negative	M	ST	LIM	L
	- loss of habitat	Negative	H	ST	LIM	L
Installation of culverts and stormwater drains	- channeling of storm water	Positive	M	LT	L	M
	- migration points for fauna	Positive	M	LT	L	M
Establishment of temporary access roads and tracks	- loss of habitat	Negative	M	ST	LIM	L
	- ecosystem disruption, fragmentation and elimination	Negative	M	ST	LIM	L

<b>Main activity</b>	<b>Impacts</b>	<b>Nature</b>	<b>Intensity</b>	<b>Duration</b>	<b>Extent</b>	<b>Significance</b>
Construction of contractor's camp	- loss of habitat	Negative	H	MT	L	M
	- loss of endemic and near endemic flora and fauna	Negative	H	MT	L	M
	- ecosystem disruption, fragmentation and elimination	Negative	H	LT	L	H
Waste disposal	- pollution of flora and fauna	Negative	M	ST	LIM	L
	- loss of habitat	Negative	M	ST	LIM	L
Temporary ablution facilities	- pollution of flora and fauna	Negative	M	ST	LIM	L
	- loss of habitat	Negative	M	ST	LIM	L
Creosoting yard	- loss of habitat	Negative	H	ST	LIM	L
	- pollution of flora and fauna	Negative	M	ST	LIM	L
Asphalt plant and application of wearing course	- pollution of flora and fauna from fumes	Negative	M	MT	LIM	M
	- pollution of flora and fauna from spillages and leakages	Negative	M	MT	LIM	M
Diesel tanks and refueling point	- pollution and consequent loss of habitats, flora and fauna from leakages and spillages	Negative	M	MT	LIM	M
Concrete batch plant	- pollution and consequent loss of habitat, flora and fauna from spillages and leakages	Negative	M	MT	LIM	M
Aggregate stock piles	- loss of habitat	Negative	M	MT	LIM	M
	- loss of endemic and near endemic flora and fauna	Negative	M	MT	LIM	M

<b>Main activity</b>	<b>Impacts</b>	<b>Nature</b>	<b>Intensity</b>	<b>Duration</b>	<b>Extent</b>	<b>Significance</b>
Traffic flows	- Loss of fauna through road kills	Negative	<b>H</b>	<b>MT</b>	<b>L</b>	<b>M</b>
	- Flora and fauna smothered by fume particles	Negative	<b>H</b>	<b>MT</b>	<b>LIM</b>	<b>M</b>
Labour force	- Loss of endemic and near endemic flora and fauna due to trampling	Negative	<b>M</b>	<b>ST</b>	<b>LIM</b>	<b>L</b>
	- Loss of fauna due to poaching	Negative	<b>M</b>	<b>MT</b>	<b>L</b>	<b>M</b>
	- loss of trees due to extraction	Negative	<b>M</b>	<b>LT</b>	<b>L</b>	<b>M</b>

**Intensity:** (H=High; M=Moderate; L=Low); **Duration:** (LT=Long term; MT=Medium term; ST=Short term; PT=Permanent); **Extent:** (LIM=Limited to site; L=Local<2km; R=Regional/provincial; N=National); **Significance:** (H=High; M=Medium; L=Low; VL=Very low; N=Neutral)

**Table 3.4 Mitigation of impacts during the construction phase**

<b>Project activity</b>	<b>Impact</b>	<b>Mitigation</b>	<b>Monitoring</b>	<b>Impact level before Mitigation</b>	<b>Impact level after Mitigation</b>
Vegetation clearance along the route	Habitat and individual plant loss	Strictly limit clearance to required dimensions Operate during the day to give animals chance to escape	Clearance confined to actual road area	H	M
Topsoil removal and storage	Disturbance of habitat	Move top soil only when it is unavoidable to do so	Earth movement scars	H	M
Development at borrow pits	Habitat loss, dust, leakages	Minimize disturbed area by limiting size to what is necessary, use dust suppression techniques such as sprinkling of water	Borrow pits scars, dust on adjacent environs	H	M
Blasting of cuttings	Dust, noise, vibrations	Blast during daytime only to avoid disturbance on nocturnal fauna, use dust suppression methods.	Dust on adjacent environs, blasting schedule	H	L
Excess soil disposal	Habitat loss	Use removed soil to cover borrow pits after use	Soil heaps	H	L
Grading	Habitat loss, vibrations noise, trampling	Limit grading to required dimensions Operate during daytime to give fauna chance to escape	Graded area maps Grading schedule	H	M

<b>Project activity</b>	<b>Impact</b>	<b>Mitigation</b>	<b>Monitoring</b>	<b>Impact level before Mitigation</b>	<b>Impact level after Mitigation</b>
Laying of base course and sub-base layers	Introduction of alien species, spillages	Use local materials to limit chance of introduction of alien species	Records of sources of materials	H	L
Installation of culverts and stormwater drains	Habitat disturbance	Utilize the existing drainage system	Map/plan of culverts and drains	M	L
Establishment of temporary access roads and tracks	Habitat disturbance; opening access to poaching	Avoid off road driving and only open temporary roads when it is really necessary to do so Rake tracks to conceal way	Map/plan of temporary roads	H	L
Construction of contractor's camp	Poaching, introduction of alien species, pollution,	Use Arandis as a base for camps to avoid human concentration in the Conservancy and poaching	Evidence of slaughtered animals, use of local fuel wood, Record of alien species observed	H	L

<b>Project activity</b>	<b>Impact</b>	<b>Mitigation</b>	<b>Monitoring</b>	<b>Impact level before Mitigation</b>	<b>Impact level after Mitigation</b>
Waste disposal	Introduction of alien species, habitat disturbance, change of scenery	Use Arandis land fills for all waste Collect all waste generated on Provide waste collection containers for workers to use Prohibit dumping of any waste in the area	Records of waste disposal at Arandis landfill. Observed littering	H	L
Temporary ablution facilities	Introduction of alien species in dung, change of scenery, general pollution, disease transmission	Use mobile latrines which can be emptied into Arandis sewer system	Mobile latrines in place	H	L
Creosoting yard	Carcinogenic contamination	Fence off to ward animals and people. Avoid spillages as much as possible	Fence in place. Observed spillages Materials balance records	H	M

<b>Project activity</b>	<b>Impact</b>	<b>Mitigation</b>	<b>Monitoring</b>	<b>Impact level before Mitigation</b>	<b>Impact level after Mitigation</b>
Asphalt plant and application of wearing course	Change of scenery	Limit application and spillages to road surface	Asphalt application plan	M	L
Diesel tanks and refueling point	Fires, soil pollution through leakages	Avoid leakages, spillages Locate on unvegetated plains to reduce risk of fire	Record and evidence of fires and liakages	M	L
Water holding ponds	Access by wild animals	Fence off, avoid leakages	Fences in place	M	L
Aggregate stock piles	Habitat loss; introduction of alien species, change of scenery,	Locate close to the road as possible to avoid unnecessary temporary access roads, locate on less vegetated plains (avoid sino bacteria colonies though bare)	Plan/map of stock piles. Records of alien species observed	H	L
Labor force	Poaching, introduction of alien species,	Police and regulate Use local labor force as much as possible Educate workers on anti poaching, waste disposal and general conduct expected in the conservancy	Records of origins of employees Records relating to poaching Records of education workshops having been held	H	L

H – high; M – medium; L - Low

### 3.3 Impacts during operation

The road will be a private road utilized by Areva Uranium to transport various equipment and resources to and from the mine as follows:

**Table 3.5 Chemicals to be transported along the proposed road**

Chemicals	Application/Description
Sodium carbonate (soda ash)	Dissolution of carnonite to form uranyl carbonate – the most essential reagent on site
Sodium bi-carbonate	Neutralization of the hydroxyl ion in the heap leach to prevent Sodium Diuranate (SDU) precipitation
Sodium hydroxide (caustic soda) flake	pH conditioning before ion exchange to minimize vanadium adsorption, as well as the precipitation of SDU from IX eluates
50% Sodium hydroxide (caustic soda) lye	Made from the caustic soda flake/pearl
98% Sulphuric acid	to redissolve the SDU to remove impurities from yellowcake
50% Hydrogen peroxide	To precipitate UO <sub>4</sub> (yellowcake)
Various non-ionic and anionic flocculants (if required)	Useful, but not preferred. Will definitely not be used for SDU settling, but may be used to settle UO <sub>4</sub> (pending test work and effect on final product purity)
Ion exchange resins	For adsorption (and therefore concentration) of dissolved uranyl carbonate

Source: Chapter 4 – Project description, Trekkopje Uranium Project Final ESIA Report, January 2008

These chemicals will be imported into Walvis Bay port and then transported either by rail or road to the Trekkopje mine site as follows:

**Table 3.6 Chemicals required by the mine and mode of transport**

Chemical	Mode of Transportation
Sodium Bicarbonate (soda ash)	<ul style="list-style-type: none"> <li>- Bulk shipments of 15000 – 30000 t each into Walvis Bay port</li> <li>- Rail train from Walvis Bay port to Arandis siding</li> <li>- Fleet of road trains from Arandis siding to processing plant (40km)</li> </ul>
Sodium Bicarbonate	<ul style="list-style-type: none"> <li>- Bulk shipments of 2000 – 3000 t each into Walvis Bay port</li> <li>- From Walvis Bay to Arandis siding and then onwards to processing plant, transportation similar to Soda ash.</li> </ul>

Soda Ash/Bicarbonate Blend	<ul style="list-style-type: none"> <li>- Bulk shipments of 15000 – 30000 t each into Walvis Bay port</li> <li>- From Walvis Bay port to Arandis siding and then onwards to processing plant, transportation similar to Soda ash</li> </ul>
Caustic soda	<ul style="list-style-type: none"> <li>- Bulk shipment of 1000 – 2000 t each/20 -24 t into the port of Walvis Bay</li> <li>- From Walvis Bay port, road transportation on flat-bed trucks directly to the processing plant at Trekkopje site</li> </ul>
Hydrogen Peroxide	<ul style="list-style-type: none"> <li>- Bulk shipments of 20 t into the port of Walvis Bay</li> <li>- From Walvis Bay to Trekkopje site transported on flat-bed trucks as Caustic soda</li> </ul>
Sulphuric acid	<ul style="list-style-type: none"> <li>- Bulk shipments of 15 t each into Walvis Bay port</li> <li>- From Walvis Bay port to Trekkopje site, transported on flat-bed trucks as Caustic soda</li> </ul>
Fuel and lubricants	<ul style="list-style-type: none"> <li>- Delivered to Trekkopje site either by rail tank cars to Arandis siding and then onwards to Trekkopje site by trucks or directly to the site by trucks</li> </ul>
Explosives	<ul style="list-style-type: none"> <li>- Two ANFO/emulsion trucks will deliver bulk explosives to the blast sites</li> </ul>

The road transportation of the chemicals and other equipment to the processing plant is of relevance to this study because it provides a picture of how much activity will be taking place on this proposed access road. While it is not clear from the TORs, we assume that the heavy loads that are to be transported from the Arandis siding to the mining site pose a challenge to Areva to use the current road. According to the ESIA report (Turgis, 2008), a fleet of road trains will be used and each road train will consist of a horse and three (3) trailers, with each trailer capable of carrying 2 x 6m iso-containers. Each road train will thus deliver 120 t of chemical (e.g. soda ash) at a time to the main processing plant. Based on the requirement for soda ash, it is deemed necessary to run a fleet of 3 – 4 road trains between Arandis siding and the main processing plant daily.

Some of the chemicals, for example, Caustic Soda, will be transported by road on flat bed trucks directly from Walvis Bay port to Trekkopje processing plant in loads of 24 -34 t per truck.

The impacts and their mitigations on the road during operation are therefore assessed based on the above-described activities as outlined in Tables 3.7 and 3.8.

**Table 3.7 Description of impacts during the operation phase**

Main activity	Impacts	Nature	Intensity	Duration	Extent	Significance
Traffic flow	- Loss of fauna through road kills	Negative	H	LT	L	H
	- loss of endemic and near endemic flora and fauna through pollution (fumes)	Negative	H	LT	LIM	M
	- disruption of migration corridor for fauna	Negative	H	LT	L	H
	- introduction of alien species	Negative	M	MT	LIM	M
	- introduction of flora and fauna diseases	Negative	M	MT	LIM	M
Occasional Maintenance	- Soil contamination from chemicals used to kill weeds on the road	Negative	M	ST	L	M
	- Loss of fauna and flora through poaching and illegal extraction	Negative	M	ST	L	M
Secondary developments	- loss of flora and fauna through road expansion	Negative	M	LT	LIM	L

Intensity: (H=High; M=Moderate; L=Low); Duration: (LT=Long term; MT=Medium term; ST=Short term; PT=Permanent); Extent: (LIM=Limited to site; L=Local<2km; R=Regional/provincial; N=National); Significance: (H=High; M=Medium; L=Low)

**Table 3.8: Mitigation of impacts during the operation phase**

Main activity	Impacts	Mitigation	Monitoring	Impact level before mitigation	Impact level after mitigation
Traffic flow	Road kill	Set speed limits. Avoid road use at night Provide appropriate signage	Speed limits signs along road. Road use schedule	h	M
	Spillages and leakages of carcinogenic substances	Set emergency plan to deal with leakages of hazardous substances	Policy, plan for dealing with hazardous substance emergencies	M	L
	Noise Vibrations	Set speed limits	Speed limits signs along the road	H	L
	Exhaust fumes	Use green fuels	Records of fuel sources and fuel descriptions	H	L
	Poaching of wildlife	Operationalise security gates Enforce compliance	Physical gates in place	M	L
Occasional Maintenance	Introduction of alien species	Use local materials	Documentation of sources of materials	M	L
	Poaching of wild life	Hold anti poaching workshops with workers Enforce compliance	Attendants list at anti poaching workshops	M	L

H – high; M – medium; L - Low

The southern zone, because of its undulating features and the need for divergence to avoid the dolerites and marbles is likely to experience a high rate of road kills of fauna as it may be difficult for drivers to have a good line of view when animals are crossing. The northern zone on the other hand is going to experience the same impact but for a different reason: that there will be a high number of fauna migrating along the washes.

Driving at optimum speeds on this road will be a challenge because of the need to look out for animals; hence the rate of exhaust fumes from the vehicles carrying heavy goods will be high, resulting in high pollution of flora and fauna in the area.

Use of a road also results in the introduction of alien species as well as new flora and fauna diseases which may be carried by the traffic passing through the road. Soil contamination can also result from maintenance processes if chemicals are used to kill weeds along the road. However, these impacts are not highly significant.

### **3.4 Impacts during decommissioning**

The activities involved during the process of decommissioning include removal of all the construction facilities, ripping, grading and contouring the area, landscaping, topsoil replacement and rehabilitation. The impacts of such activities are described in Table 3.9.

While the process of decommissioning is supposed to include restoration processes, which are expected to bring largely positive impacts, some of the activities will bring negative impacts. It is therefore crucial that care be taken to enhance the positive impacts and minimize or avoid the negative impacts as per recommendations given in Table 3.10.

**Table 3.9 Description of impacts during the decommissioning phase**

Main activity	Impacts	Nature	Intensity	Duration	Extent	Significance
Removal of all construction materials	-pollution due to disposal of road materials	Negative	H	MT	L	M
	-restoration to old form of habitat	Positive	M	LT	L	M
Ripping	- restoration to old form of habitat	Positive	M	LT	L	M
Grading	- restoration to old form of habitat	Positive	M	LT	L	M
Contouring	- restoration to old form of habitat	Positive	M	LT	L	M
Landscaping	-restoration to old form of habitat	Positive	M	LT	L	M
	-introduction of alien species	Negative	M	MT	LIM	M
Topsoil replacement	-restoration to old form of habitat	Positive	H	LT	L	H
	-introduction of alien species	Negative	M	MT	LIM	M

Intensity: (H=High; M=Moderate; L=Low); Duration: (LT=Long term; MT=Medium term; ST=Short term; PT=Permanent); Extent: (LIM=Limited to site; L=Local<2km; R=Regional/provincial; N=National); Significance: (H=High; M=Medium; L=Low)

**Table 3.10 Mitigation of impacts during decommission phase**

Main activity	Impacts	Mitigation	Impact level before mitigation	Impact level after mitigation
Removal of all construction materials	-pollution due to disposal of road materials	Limit deposition to disturbed area	H	L
	-restoration to old form of habitat	Use local resources	H	L
Ripping	- restoration to old form of habitat	Limit operation to disturbed area	M	L
Grading	- restoration to old form of habitat	Limit operation to disturbed area	M	L
Contouring	- restoration to old form of habitat	avoid form that would encourage erosion	M	L

Landscaping	-restoration to old form of habitat -introduction of alien species	Avoid form that would encourage erosion	<b>M</b> <b>M</b>	<b>L</b> <b>L</b>
Topsoil replacement	-restoration to old form of habitat -introduction of alien species	Use local resource	<b>H</b> <b>M</b>	<b>L</b> <b>L</b>

H= High; M= Medium; L= Low

### 3.5 Borrow Pits

The construction of the road will require some fill material that will be obtained from borrow pits identified along the route of the road. According to Turgis (2009), 4 borrow pits will be required. The assessment of the borrow pits (Limpitlaw, 2009) provided information on the probable places to situate the borrow pits. This biodiversity study assessed the borrow pits sites in terms of the flora and fauna there present and expected.

The major impacts due to the borrow pits are the loss of flora and fauna diversity, loss of habitats, fragmentation of ecosystems and the hydrological system if the washes are blocked. As discussed above, the points that were assessed for the establishment of the borrow pits contained a varied number of flora and fauna. On the southerly side, there are a number of dolerite and marble ridges which are well known for their species diversity and richness. It is therefore recommended that the ridges are circumvented when designing the road and that there are no borrow pits located on the same. The washes should be avoided as locating the borrow pits on them would result in the disruption of the flow of water during the rainy season and damming. While during road construction this can be mitigated by constructing culverts, this option is not available when constructing borrow pits. For this reason, borrow pit number 1 cannot be developed. On the south side of the wash, there is a marble rock and it is also the beginning of the lichens zone. An alternative location for a pit would be at waypoint number 558 (S22 15.692 E14 54.520). Likewise, the proposed borrow pit number 4 (S22 20.137 E14 57.282) is located in a wash with sandy substrate; if this sand is required, alternative material to fill the borrow pit before the next flood should be applied, which would require a further borrow pit, and extend the impact. The recommendation is to locate all borrow pits outside watercourses.

Borrow pit number 3 is located very close to a large field of bushman's candle shrubs (*Sarcocaulon marlothii*), and great care should be taken to completely avoid this field during construction (besides the road corridor, which cuts through the field). The service route to the borrow pit should not go south of a line joining the borrow pit at S22 20.910 E14 57.412 with a point on the proposed road located at S22 20.811 E14 57.570.

Table 3.11 describes the impacts associated with each borrow pit. Below are the impacts that are envisaged with regards to establishing borrow pits on the suggested sites:

**Table 3.11 Borrow Pits impacts without mitigation**

Main activity	Impacts	Nature	Intensity	Duration	Extent	Significance
Excavation of aggregate and fill material	- Loss of fauna and flora	Negative	H	LT	LIM	M
	- loss of biodiversity	Negative	H	LT	L	H
	- fragmentation of ecosystem	Negative	M	LT	L	M
	- fragmentation of hydrological system	Negative	M	LT	L	
Excavation, blasting and crushing of stone	- loss of endemic and near endemic flora and fauna	Negative	H	LT	LIM	M
	- loss of habitat	Negative	H	MT	L	M
	- fragmentation of ecosystem	Negative	H	MT	L	M
	- fragmentation of hydrological system	Negative	M	MT	L	M
Access roads	- loss of vegetation and fauna	Negative	M	LT	LIM	M
	- loss of habitat	Negative	M	MT	L	M
	- disruption and fragmentation of ecosystems	Negative	M	MT	L	M
	-					
Transportation of aggregate and fill material	- road kill accidents	Negative	M	MT	L	M
	- dust smothering flora and fauna	Negative	H	MT	LIM	M
	- fumes from vehicles smothering flora and fauna	Negative	M	MT	L	M
Rehabilitation and closure	- restoration of ecosystem	Positive	M	LT	L	M
	- introduction of alien species	Negative	M	LT	LIM	M

Intensity: (H=High; M=Moderate; L=Low); Duration: (LT=Long term; MT=Medium term; ST=Short term; PT=Permanent); Extent: (LIM=Limited to site; L=Local<2km; R=Regional/provincial; N=National); Significance: (H=High; M=Medium; L=Low)

### **3.6 Mitigation of impacts during operation of borrow pits**

Table 3.11 summarized the impacts of works as largely the destruction of habitats, and bulldozing of plant communities. The nature of works that is carried out at borrow pits makes the above mentioned impacts unavoidable. As such, the key mitigation is to locate borrow pits in ecologically less sensitive area, as close as possible to the road route in order to minimize the foot print of borrow pit access roads. We recommend that as much fill material as possible ferried from the Trekkopje mine as possible, e.g. waste rock material that is otherwise piled up at the mine is disposed of by using it as road building material. This would make it unnecessary to establish any new borrow pits along the proposed road.

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## APPENDICES

### Appendix 1. List of flora and fauna species observed at waypoints

Waypoint & coordinates	Location	Fauna	Flora
<b>571</b> (S22 24.189 E14 59.033)	Stable plain and close to a marble ridge	Harvester ants ( <i>Messor</i> ), Cape hare	<i>Commiphora</i> sp., <i>Euphorbia</i> sp., <i>Zygophyllum stapffii</i> , <i>Parkinsonia africana</i> , <i>Aloe asperifolia</i> , <i>Asclepias buchenaviana</i> , <i>Stipagrostis ciliata</i> , <i>Zygophyllum simplex</i> , <i>Stipagrostis gonatostachys</i>
<b>570</b> (S22 24.039 E14 58.971)	Wash	Springbok	<i>Acacia reficiens</i> , <i>Zygophyllum stapffii</i> , <i>Parkinsonia africana</i> , <i>Blepharis</i> sp., <i>Stipagrostis ciliata</i> , <i>Zygophyllum simplex</i> , <i>Stipagrostis gonatostachys</i> , <i>Asclepias buchenaviana</i> ;
<b>569</b> (S22 23.561 E14 58.756)	On plain close to a small wash		<i>Zygophyllum stapffii</i> , <i>Parkinsonia africana</i> , <i>Acacia reficiens</i>
<b>568</b> (S22 23.461 E14 58.682)	Marble ridge	Namaqua doves ( <i>Oena capensis</i> ), Harvester termites, Ants & Honeybees	<i>Zygophyllum stapffii</i> , <i>Sarcocaulon marlothii</i> , <i>Aloe</i> sp., <i>Tamarix usneoides</i> , alien wild tobacco ( <i>Nicotiana glauca</i> ), <i>Zygophyllum simplex</i> , two <i>Eragrostis</i> grass species (one could be <i>Eragrostis nindensis</i> ), <i>Brownanthus</i> , some other succulents, shrubs and herbaceous plant present.
<b>567</b> (S22 23.025 E14 58.531)	Sandy area, end of a wash with lots of grass	Springbok tracks, Suricate ( <i>Suricata suricatta</i> ), horned adder ( <i>Bitis caudalis</i> ),	<i>Zygophyllum stapffii</i> , <i>Stipagrostis ciliata</i> , <i>Euphorbia damarana</i> , <i>Aloe</i> sp., <i>Arthroaerua</i>

	cover	termites, grasshopper, Suricate ( <i>Suricata suricata</i> )	<i>leubnitziae</i> & <i>Acacia reficiens</i>
Dolerite ridge (S22 22.333 E14 57.848)	Dolerite ridge	northern plains sand lizard ( <i>Pedioplanis cf inornata</i> nov.sp.)	<i>Euphorbia damarana</i> , <i>Zygophyllum stapfii</i> , <i>Calicorema capitata</i> , <i>Sarcocaulon marlothii</i> & <i>Commiphora</i> sp.
<b>566</b> (S22 21.807 E14 58.004)	Close to a wash	Springbok and Ostrich dung	<i>Arthroerua leubnitziae</i> , <i>Stipagrostis grass</i> sp., & <i>Sarcocaulon marlothii</i>
<b>Borrow pit 3</b> (S22°20.910'; E14°57.412)	Plain near the large bushman's candle ( <i>Sarcocaulon marlothii</i> ) field	Tenebrionid beetles ( <i>Physadesmia globosa</i> and <i>Zophosis</i> sp.), Cape hare ( <i>Lepus capensis</i> ), short- headed sand lizard ( <i>Pedioplanis breviceps</i> ), Namaqua chameleon ( <i>Chamaeleo namaquensis</i> ) eating locust, grasshopper & harvester termites,	<i>Stipagrostis grasses</i> sp., <i>Salsola tuberculata</i> , <i>Adenolobus pechuelii</i> , <i>Acacia reficiens</i> , <i>Commiphora saxicola</i> & <i>herbaceous</i> plants.
<b>565</b> (S22 20.301 E14 57.354)	Rock outcrops	Namaqua dove ( <i>Oena capensis</i> ), Honeybees, Ants, Springbok, & Butterflies	<i>Tamarix usneoides</i> , <i>Commiphora saxicola</i> , <i>Stipagrostis ciliata</i> & other grasses
<b>Borrow pit 4</b> (S22°20.137'; E14°57.282)	Wash	Springbok, Namaqua dove ( <i>Oena capensis</i> ), ground squirrel burrows	<i>Adenolobus pechuelii</i> , <i>Acacia reficiens</i> , <i>Blepahris obmitrata</i> , <i>Oleander</i> plant, gemsbok cucumber ( <i>tsamma Citrillus ecirrhosus</i> ), <i>stipagrostis</i> grass sp. <i>Arthroerua leubnitziae</i> & <i>Zygophyllum staffii</i>
<b>564</b> (S22 19.914 E14 57.186)	Wash	Burrow of ground squirrels, Springbok tracks	<i>Arthroerua leubnitziae</i> , <i>Zygophyllum stapfii</i> , <i>Commiphora</i> sp. & <i>Stipagrostis</i> grass sp.
<b>Borrow pit 5</b>	Quartz rocky	<i>Zophosis</i> beetle,	Cyanobacteria,

(S22°19.134'; E14°56.812)	area	variegated skink lizard ( <i>Trachylepis variegata</i> ), juvenile short-headed sand lizard ( <i>Pedioplanis breviceps</i> ), and burrows of ground dwelling, Suricate tracks, & Springbok	<i>Commiphora</i> sp., <i>Sarcocaulon marlothii</i> , <i>Arthroerua leubnitziae</i> , <i>Zygophyllum stapffii</i> , <i>Zygophyllum simplex</i> , <i>Euphorbia</i> sp., <i>stipagrostis</i> grasses & Salt bush
<b>563</b> (S22 18.384 E14 56.524)	Broad wash (pipe leak spot)	Springbok & Honeybees	<i>Arthroerua leubnitziae</i> , <i>Zygophyllum stapffii</i> & <i>Zygophyllum simplex</i>
<b>562</b> (S22 17.274 E14 56.084)	Close to dolerite ridge (Sensitive area)	Northern plains sand lizard ( <i>Pedioplanis cf inornata</i> nov.sp.)	Lichen, <i>Salsola</i> sp., <i>Arthroerua leubnitziae</i> , <i>Zygophyllum stapffii</i> , <i>Larryleachia</i> sp. & some succulent plants
<b>561</b> (S22 16.940 E14 55.601)	Gravel plain (pipe leak spot)	Honeybees	<i>Stipagrostis</i> grass sp. other grass species.
<b>560</b> (S22 16.784 E14 55.464)	Wash		<i>Salsola</i> sp., <i>Lycium</i> sp., <i>Calicorema capitata</i> & <i>stipagrostis</i> grasses.
<b>559</b> (S22 16.530 E14 55.243)	Wash close to quartz hill	Springbok, butterflies	<i>Calicorema capitata</i> , <i>Zygophyllum stapffii</i> , <i>Sasenum</i> sp., gemsbok cucumber ( <i>tsamma Citrillus ecirrhosus</i> ), <i>Arthroerua leubnitziae</i> and <i>Blepharis</i> sp. <i>Asclepias</i> sp, <i>Stipagrostis</i> grass sp.
<b>Borrow pit 2</b> (S22°16.153'; E14°54.921)	Quartz rocks field and shallow wash	<i>Zophosis</i> beetle, stonehopper (Pamphagidae: <i>Trachypetrella</i> ), harvester termites, teddybear solifugid ( <i>Hexisopus</i> sp.), <i>tractrac chat</i> birds, Namaqua chameleon, Cape hare ( <i>Lepus capensis</i> ), springbok, Korhaan, sandgrouse, burrows	Cyanobacteria, <i>Commiphora</i> sp., <i>Arthroerua leubnitziae</i> , <i>Zygophyllum stapffii</i> , <i>Sarcocaulon marlothii</i> , <i>Stipagrostis</i> grasses and some succulent plants

		of striped fieldmouse <i>Rhodomys pumilio</i>	
<b>558</b> (S22 15.692 E14 54.520)	Quartz rocks field and close to a wash	Springbok, Black backed Jackal ( <i>Canis mesomelas</i> ) tracks and dung scent-mark, springbok tracks, and aardvark ( <i>Orycteropus afer</i> ) burrows, Antlions	<i>Cyanobacteria</i> , <i>Arthraerua leubnitziae</i> , <i>Zygophyllum stapffii</i> & <i>Stipagrostis</i> grass sp.
<b>Borrow pit 1</b> (S22°15.522'; E14°54.366)	Strong wash and hard rock outcrop	Cape hare, Springbok	Lichens, <i>Arthraerua leubnitziae</i> , <i>Zygophyllum stapffii</i> , <i>Calicorema capitata</i> & <i>Monechma genistifolium</i>
S22.23417 E014.88470	Gravel plain with narrow shallow wash	Aardvark ( <i>Orycteropus afer</i> ) burrows, tenebrionid ( <i>Metriopus depressus</i> )	<i>Zygophyllum stapffii</i> & <i>Stipagrostis</i> grass sp.
S22.21197 014.86687	Gravel plain	Aardvark ( <i>Orycteropus afer</i> ) burrows & locust	<i>Zygophyllum stapffii</i> & <i>Stipagrostis</i> grass sp.
S22 12.717 E14 51.998	Wash	Springbok, birds, and burrows of ground dwelling creatures	<i>Zygophyllum stapffii</i> , <i>stipagrostis</i> grass species
S22 14.052 E14 53.083	Wash, plains, ridges	Cape hare ( <i>Lepus capensis</i> ), Ludwig's bustard ( <i>Neotis ludwigii</i> ), Birds, <i>Metriopus</i> beetle	Bitter bush ( <i>Pechuel- Loeschea leubnitziae</i> ), Wild ebony ( <i>Euclea pseudebenus</i> ), <i>Monechma genistifolium</i>

## Appendix 2: Impact Rating (Adapted from Turgis, 2008)

<b>Nature</b> of the impact	
- + Neu	Negative Positive Neutral
<b>Intensity: Negative Impacts</b>	
Low (L)	The impact has no effect on natural, cultural and social functions and processes beyond that of nuisance value,
Moderate (M)	Natural processes and cultural and social functions continue, but in a modified way.
High (H)	Natural processes or cultural or social functions are altered to the extent that they temporarily or permanently cease, resulting in severe deterioration of the impacted environment.
<b>Intensity: Positive Impacts</b>	
Low (L)	The impact has a slight positive effect on natural, cultural and social functions and processes.
Moderate (M)	Natural processes and cultural and social functions continue in a noticeably enhanced way.
High (H)	Natural processes or cultural or social functions are altered to the extent where the sustainability of the impacted environment is considerably advanced.
<b>Duration: life-time of the impact</b>	
Short term (ST)	0-5 years, the effects can be reversed in a short time
Medium term (MT)	5-15 years, the effects could be reversed over a medium time period, possibly coinciding with the life of mine.
Long term (LT)	The impact will only cease after the operational life of the Trekkopje Uranium Project.
Permanent (PT)	The impact on the receiving environment will effectively be irreversible.
<b>Extent: the geographical extent of the impact</b>	
Limited (LIM)	The impact is limited to the

	tenement/mine site
Local (L)	The impact will extend beyond the immediate boundaries of the mining tenement, affecting the environment/one or more of the communities in Arandis, Spitzkoppe and Swakopmund.
Regional (R)	The impact will affect Erongo Region.
National (N)	The impact will affect Namibia
<b>Significance (Biodiversity)</b>	
High (H)	For negative impacts, the decision should be not to proceed with the project. For positive impacts, the impact supports the implementation of the project.
Medium (M)	This impact will not be avoided unless mitigation measures are put in place and could require modification of the project design.
Low (L)	The impact will not affect the decision to proceed with the project and will not need to be considered in the project design.
<b>Significance Ratings (arrived at by considering Duration, extent and intensity)</b>	<b>Level of Criteria Required</b>
<b>High (H)</b>	<ul style="list-style-type: none"> <li>• High magnitude with a regional extent and long term duration</li> </ul>
	<ul style="list-style-type: none"> <li>• High magnitude with either a regional extent and medium term duration or a local extent and long term duration</li> </ul>
	<ul style="list-style-type: none"> <li>• Medium magnitude with a regional extent and long term duration</li> </ul>
<b>Medium</b>	<ul style="list-style-type: none"> <li>• High magnitude with a local extent and medium term duration</li> </ul>
	<ul style="list-style-type: none"> <li>• High magnitude with a regional extent and construction period or a site specific extent and long term duration</li> </ul>
	<ul style="list-style-type: none"> <li>• High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration</li> </ul>
	<ul style="list-style-type: none"> <li>• Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term</li> </ul>

	<ul style="list-style-type: none"> <li>• Low magnitude with a regional extent and long term duration</li> </ul>
<b>Low</b>	<ul style="list-style-type: none"> <li>• High magnitude with a site specific extent and construction period duration</li> </ul>
	<ul style="list-style-type: none"> <li>• Medium magnitude with a site specific extent and construction period duration</li> </ul>
	<ul style="list-style-type: none"> <li>• Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term</li> </ul>
	<ul style="list-style-type: none"> <li>• Very low magnitude with a regional extent and long term duration</li> </ul>
<b>Very Low</b>	<ul style="list-style-type: none"> <li>• Low magnitude with a site specific extent and construction period duration</li> </ul>
	<ul style="list-style-type: none"> <li>• Very low magnitude with any combination of extent and duration except regional and long term</li> </ul>
<b>Neutral</b>	<ul style="list-style-type: none"> <li>• Zero magnitude with any combination of extent and duration</li> </ul>