GOANIKONTES URANIUM PROJECT

VEGETATION STUDY



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1. TERMS OF REFERENCE AND OBJECTIVES

The Namib Desert harbours numerous endemic and near endemic plant species, of which many are of restricted distribution or habitat. This makes them extremely vulnerable to disturbance. The floral specialist study aims to:

- By means a field reconnaissance survey and review of relevant information, identify the plant species that occur or are thought to occur on the site, with emphasis on those that are valuable from a biodiversity and/or ecological point of view.
- Classify the area into broad habitat zones according to vulnerability, ecological and scientific value.
- Identify and assess the potential impacts on the flora resulting from the proposed mining activities during both development and operational phases. It is important to note that the exact location of the various facilities have not been determined yet. It was therefore assumed that mining activities will be concentrated in the zones of the indicated areas of interest (Appendix 1).
- Suggest mitigating measures to avoid or minimise impacts. The vegetation was to be considered regarding sensitivity to disturbance created by both direct and indirect impacts.

2. APPROACH

- Review of relevant existing information, including literature sources, known plant species distribution according to the National Herbarium Database (SPMNDB) as well as species and area conservation status.
- Site visit and field survey of the area (9-13 April 2008) by means of walked and driven belt transects, concentrating on the deposit areas (in order of priority as indicated by mining staff) and potential sites for establishment of infrastructure, to record the local flora in as much detail as possible, identifying sensitive species and where they are concentrated. Collection of voucher specimens of selected species considered to be of importance, and species in need of identification in the National Herbarium.
- Combine species list from the National Botanical Research Institute and identified specimens in order to obtain as comprehensive a data set as possible and list species of conservation concern (i.e. Red Data species and those protected by Nature Conservation and Forestry legislation).
- Suggest potential and realistic mitigation measures where and if necessary, as well as possible long-term monitoring strategies, if the necessity for such is apparent.
- Preparation of report.

Nomenclature largely follows Craven (Ed.) 1999. All voucher specimens collected will be lodged at the National Herbarium of the National Botanical Research Institute, Windhoek.

All locality data are cited in WGS84 UTM Z33S.

3. LEGAL AND POLICY REQUIREMENTS

3.1 Acts and ordinances

Namibia's Constitution provides for the protection of the environment in Article 95, which says: "The State is obliged to ensure maintenance of ecosystems, essential ecological processes and biological diversity and utilisation of living natural resources on a sustainable basis for the benefit of Namibians both present and future".

Plant species are protected by various mechanisms in Namibia, including Nature Conservation Ordinance No. 4 of 1975, including amendments, and Forestry Act No. 72 of 1968.

The Environmental Management Bill of 2007 fixes principles for decision-making on issues affecting the environment.

3.2 Namibian commitment to international standards and/or guidelines

Namibia is a signatory to the Convention on Biodiversity, committing it to the preservation of species, particularly rare and endemic species, within its boundaries. As a signatory also to the Convention to Combat Desertification it is also bound to prevent excessive land degradation that may threaten livelihoods.

4. DESCRIPTION OF SURVEYED AREAS AND RECOMMENDATIONS

4.1 General location

The Goanikontes Uranium project area (EPL3345) is situated in the central Namib Desert, in the Erongo Region of Namibia, south-east of Swakopmund. The portion of the EPL north of the Swakop River lies within the West Coast Recreation Area, and that south of the river (where mining activities will begin, should clearance be obtained) lies within the Namib-Naukluft National Park, a formally protected area.

The central Namib lies between the ephemeral Ugab and Kuiseb rivers, and is bounded by the Atlantic Ocean in the west and the escarpment in the east. It falls into the Desert Biome of southern Africa (Rutherford & Westfall 1986) and the Desert Biome of Irish (1994).

4.2 Climate

4.2.1 Temperature

Average daily temperatures vary between a minimum of 10° C in the coldest month and a maximum of 32° C in the warmest month in the area (Mendelsohn et al. 2002). Due to coastal proximity frost is probably rare.

4.2.2 Wind

Southerly, westerly and south-westerly winds are prevalent, and are usually strongest between late afternoon and early evening (Mendelsohn et al. 2002).

4.2.3 Moisture

Rainfall in the Namib Desert is highly variable, unpredictable, and patchy. It varies from 0 to approximately 100 mm p.a. (Mendelsohn et al. 2002), increasing from west to east. In the west, where precipitation from rain is lowest, fog that is carried inland by wind passing over the cold Benguela current of the Atlantic Ocean is a vital source of moisture for many desert organisms. The number of fog days p.a. decreases eastwards (Olivier 1995), but fog does reach the study area and probably provides a proportion of the moisture available.

4.3 Topography

The Goanikontes EPL, which to date includes thirteen indicated areas of potential mining interest (Appendix 1), may broadly be divided into four zones, of which two may be further subdivided. Overall it consists largely of sandy gravel plains dissected by ephemeral watercourses and washes that generally trend north-east \rightarrow south-west. As may be seen in Appendix 1, these plains are incised towards the southern reaches of the EPL by the canyon of the westward-flowing ephemeral Swakop River. The gravel plains to the north of the river tend to lie higher than the river, draining towards it, while a little south of the river the plains again drain towards the south rather than towards the river. In the vicinity of the river on both sides the plains (Zone A) tend to gradually metamorphose into gravelly, undulating gravelly-gneiss hillocks dissected by narrow sandy washes (Zone B), finally becoming a broad band of high mountainous ridges forming the canyon, dissected by sandy washes of varying size and accessibility (Zone C), that demarcate the route of the Swakop River (Zone D). Zones B and C drain towards the river. Appendix 2 offers an approximate indication of these zones.

In Zone A (the plains) there are scattered rocky outcrops of varying composition, including marble ridges.

Table 1 summarises the character of these zones, species of conservation concern and vegetation sensitivity, as well as any suggested mitigation measures. They are discussed in detail later. Of the thirteen areas of interest indicated on Appendix 1, eight were visited during this study. Each of these is individually discussed later in the context of which zones will be impacted (Section 5). Four of the unvisited sites appear, from inspection of the satellite image, to occur in Zone A (R7, R9, Alaskite) and Zone B (R8). The Namib Pb Anomaly cannot be zoned with any confidence based on this study.

Zone	Description	Subdivision		Species of conservation concern (red = high) and vegetation sensitivity	Suggested mitigation measures
А	Sandy-Gravel plains	1	Plain	None, sensitivity low	General, strict track control
		2	Drainage lines and washes	Zygophyllum stapfii, Arthraerua leubnitziae, Adenolobus pechuelii, sensitivity low	Avoid large washes, maintain drainage where possible
		3	Rocky outcrops	Aloe asperifolia, Hoodia pedicellata (mostly restricted to large marble ridges), sensitivity medium	Avoid large marble ridges in the Ombuga deposit if possible. Plant rescue and relocation of <i>Aloe</i>

Table 1: Vegetation zones in the study area.

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					and <i>Hoodia,</i> possibly others
В	Gravelly-gneiss hillocks			Aloe asperifolia, Zygophyllum stapfii, Arthraerua leubnitziae, Petalidium variabile, Adenolobus pechuelii, sensitivity low	Rescue and relocation of <i>Aloe</i>
С	Mountainous ridges (canyon)			Commiphora oblanceolata, Zygophyllum stapfii, Arthraerua leubnitziae, Petalidium canescens, P. variabile, sensitivity medium	Rescue and relocation of <i>Commiphora</i> <i>oblanceolata</i>
D	Swakop River and large valleys that drain into it	1	Swakop River	Acacia erioloba, Euclea pseudebenus, Faidherbia albida, Petalidium canescens, sensitivity low	None useful, control of unnecessary collateral damage
		2	Other large valleys and drainage lines	A. erioloba, Euphorbia virosa, Zygophyllum stapfii, A. leubnitziae, Codon royenii, Petalidium variabile, sensitivity low	None useful, control of unnecessary collateral damage

4.4 Vegetation

While approximately 17% of the Namibian flora as a whole is thought to consist of endemic species (Barnard 1998), over 30% of plants that occur in the Namibian section of the Desert Biome are believed to be endemic to that area. This is a remarkably high figure, but in the context of this project it is important to note that the areas of highest plant endemicity in the Namib are the Kaokoveld and the southern Namib, both regarded as major centres of endemicity in Namibia (Maggs et al. 1998). Levels of plant endemicity are comparatively lower in the central Namib. This notwithstanding, the proportion of endemic plants recorded in the general area (quarter-degree 2214DB, Appendix 3) is still high, at 18%. The total proportion of endemic and near-endemic species is 31% (Appendix 2). Not all the plants listed in Appendix 3 will necessarily be present in the study area because the list is generated from the database of the National Herbarium, which is based on quarter-degree squares, as well as from observations and collections during this study. Nevertheless it is indicative of the sensitivity of this area and the necessity to minimise the extent of impacts as far as possible.

4.4.1 Zone A. Sandy-Gravel plains

A large proportion of the EPL consists of sandy-gravel plains, which are extremely sensitive to vehicle tracks, particularly where a gypsum crust is present. During this study it was found that these plains differ slightly in their species composition and richness from north to south, with the northern plain exhibiting greater species diversity than the southern. This is probably a result of local rainfall patterns this season influencing the number of annual plant species observed in any given area during the study period.

The sub-zones within Zone A may be described as follows:

A.1. Plains

South of the Swakop River these plains were almost bare of plants (Figure 1), with almost all growth being confined to the washes (sub-zone A2). North of the river there were small patches of growth, usually composed of the near-endemic

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annual grass *Aristida parvula, Enneapogon desvauxii* and *Ophioglossum polyphyllum.* After rains it may be expected that these plains will be covered in grasses, annuals and geophytes that are presently not apparent. Characteristic remains of *Blepharis grossa,* a near-endemic annual herb, were apparent throughout the zone, and many newly-germinated seedlings were present but not identifiable.



Figure 1: Most of the perennial vegetation in the plains is confined to the washes

A.2. Drainage lines and washes

Throughout the plains there are shallow ephemeral washes that carry perennial vegetation, as well as several larger drainage lines (e.g. in the vicinity of the Ombuga deposit). These are all characterised by the ubiquitous presence of *Zygophyllum stapfii* (dollar-bush, figure 2) and *Arthraerua leubnitziae* (Figure 3), both Namib Desert endemics, as well as the near-endemic *Adenolobus pechuelii* subsp. *pechuelii* (Figure 4) and *Hermbstaedtia spathulifolia*, another Namibian endemic. The larger drainage lines carry a more diverse range of perennials, including *Acacia reficiens, Cryptolepis decidua* and *Gomphocarpus filiformis*.



Figure 2: *Zygophyllum stapfii* (dollar bush)



Figure 3: Arthraerua leubnitziae



Figure 4: Adenolobus pechuelii subsp. pechuelii

A.3. Rocky outcrops

A number of rocky outcrops of varying composition are scattered throughout the plains. Most were found to harbour virtually no plants, particularly the smaller outcrops. However, in addition to *Z. stapfii* and *A. leubnitziae*, *Aloe asperifolia* and *Hoodia pedicellata* (Figures 5 & 6) both protected species, the former endemic and the latter near-endemic, occur on the larger ridges, particularly on marble and limestone/dolomite substrates (Figure 7).



Figure 5: Aloe asperifolia



Figure 6: *Hoodia pedicellata*



Figure 7: Large rocky ridges, such as this one in the vicinity of the Ombuga deposit, harbour protected succulent species.

Recommendations – Zone A

Providing that the problems mentioned below are addressed, mining could be permitted in Zone A without major impacts on any plant species of high conservation concern. The most important impact in this zone will be the loss of relatively unspoilt scenic vistas of possible importance to tourism in the parks.

In Zone A strict track control will be essential during all exploration, construction and mining phases. Tracks to be used should be clearly demarcated from very early on, and transgressors should be penalised. Tracks made in areas that prove unsuitable for mining should be rehabilitated in cooperation with the chief ranger of the Namib-Naukluft Park.

Although numerous individuals of plant species typical of washes (e.g. *Z. stapfii, A. leubnitziae, H. spathulifolia* and *A. pechuelii*) in the central Namib will be destroyed by mining activities in this zone (and others), they are very common in the central Namib. Nevertheless wherever possible large drainage lines/washes should be conserved (see discussion on Anomaly A) so as to restrict possible large-scale losses of "downsteam" populations of endemics and near-endemics that lie outside the deposits. Although common and appearing to readily recolonise disturbed areas, these species will potentially be impacted by a number of large developments and the cumulative losses may yet prove to be of concern. Loss of populations outside the mining area due to impeded drainage would be a highly undesirable form of collateral damage.

Species that occur on the rocky outcrops, such as *Aloe asperifolia* and *Hoodia pedicellata* are less common, with a far more limited habitat. *Aloe namibensis, Lithops ruschiorum* and *Larryleachia marlothii* may potentially also be of concern on rocky ridges, as they are known to occur in the area even though they were not recorded during the survey. Wherever possible mining activities should be kept away from the larger rocky ridges (e.g. see discussion on Ombuga) carrying species of conservation concern. As a last resort controlled rescue and relocation of protected species could be considered. However, see discussion of this issue under Section 8 later.

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Lichens are not plants, and thus do not fall into the scope of this report. However it may be useful to mention that the lichen plains of the Namib are known for their high diversity and are thought to harbour many undiscovered species (Barnard 1998). It was noted that several of the higher-lying rocky ridges on the plains carried a rich lichen population, particularly on the south-western slopes (Figure 8). This emphasises the necessity to conserve high-lying areas such as rocky outcrops where possible.



Figure 8: Lichen diversity on a rocky ridge near the Ombuga deposit.

4.4.2 Zone B. Gravelly-gneiss hillocks

These undulating hillocks (Figure 9) fall between the plains and the mountainous ridges that form the canyon of the Swakop River. Superficially they appear largely unvegetated, but they are dissected by narrow, sandy-rocky washes that harbour considerable plant life, including endemic and near-endemic species, and are characterised by *Z. stapfii, A. leubnitziae, Asparagus pearsonii, Adenolobus pechuelii, Petalidium variabile, Sesuvium sesuvioides* and *Cryptolepis decidua. Aloe asperifolia* (endemic, protected) occurs in very low numbers on rocky substrates in lateral gullies on these washes (Figure 10). It is the only listed species of



formal conservation concern that was found in this zone.

Figure 9: Gravelly-gneiss hillocks north of the Anomaly A deposit

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Figure 10: *Aloe asperifolia* in gullies at the southern end of the Oshiveli deposit

Recommendations – Zone B

Mining could be permitted in Zone B without major impacts on any plant species of high conservation concern. Some suggestions for mitigation are provided below, but are not absolutely essential.

Due to the fact that vegetated washes that carry the species of conservation concern are distributed throughout this zone, and that they are not very large, it will not be possible to avoid damaging them or to single out any particular ones for saving, and in the event of the zone being mined the only possible form of mitigation would be to rescue/relocate the aloes and any other protected succulents that may be found (see Section 8). The other endemics and near-endemics that occur here are not suited to this purpose. They are not, however, threatened or protected species and are reasonably widely distributed in the central Namib.

Adenia pechuelii (Figure 4) is coming into flower at present, so possibly the National Plant Genetic Resources Centre (NPGRC) should be requested to do seed collection if they have time later in the year. Alternatively, should they want the seed and not have time to collect, then someone could be contracted to undertake seed collection on their behalf.

4.4.3 Zone C. Mountainous ridges (Swakop River Canyon)

Between the undulating hillocks and the river lies a broad belt of high, steep mountainous ridges that form the Swakop River canyon (Figure 11). These are dissected by many narrow rocky-sandy washes but also by some broad, sandy valleys that will be discussed under Zone D.



Figure 11: The Swakop River Canyon is formed by mountainous ridges on either side of the sandy riverbed.

As was found in the previous zone, the slopes of these koppies are largely unvegetated. However, the washes that run through them support a diverse vegetation. Endemics and near-endemics found here include *Z. stapfii, A. leubnitziae, Petalidium canescens* (Figure 12) and *Commiphora oblanceolata* (the Swakopmund commiphora, Figures 13 & 14). The latter has a disjunct distribution in the Kaokoveld and the central Namib, where it is found only along the Swakop and Khan rivers, usually in small populations of a few, scattered individuals, and on a few rocky outcrops and koppies in the vicinity of the rivers. It was assessed as Near-Threatened in 2002, will be affected by all mining developments near the rivers, and is the species of the highest conservation concern in the EPL. Thus, although it has not been recently assessed by the *in-situ* conservative attitude be assumed, and that that it be assigned a high priority due to its limited habitat potentially being reduced by several large developments in the vicinity of the Khan and Swakop Rivers.



Figure 12: Petalidium canescens



Figures 13 & 14: Commiphora oblanceolata



Recommendations – Zone C

No protected plant species were found in this zone. As mentioned, the species of highest concern is *Commiphora oblanceolata,* which does not yet enjoy protected status. However, the canyon *per se* is a valuable asset, as yet underutilised, to the National Park. It is structurally scenic, and contributes hugely to the character and scenic value of the river, and thus to tourism in the Namib-Naukluft National Park. It is recommended that mining of this zone be restricted to areas at least 1 kilometre removed from the river (see Appendix 2) in order to maintain this resource for future park developments such as camps and hiking routes.

If and where mining is permitted in this zone, then rescue and removal or possibly controlled and monitored relocation of *Commiphora oblanceolata* could be undertaken. However, except in the Onkelo and northern section of the Oshiveli deposits they occur in low numbers, and if such activities are undertaken they should be concentrated in those areas. The NBRI could be consulted regarding the possibility of involving a commercial nursery in the exercise. Potentially the National Botanic Garden in Windhoek could be approached to assess the potential for propagation by means of cuttings. Ideally seed collection should be undertaken by the NPGRC, but this is complicated by the fact that seed maturation is sporadic, and occurs over an extended period of time and space.

4.4.4 Zone D. Swakop River and large valleys draining into it

The Swakop River is one of several large, ephemeral western-flowing watercourses in Namibia. Within this EPL are also a number of broad valleys that lead down to the river itself (e.g. north of Ompo, east of Oshiveli and Onkelo).

D.1. Swakop River

This sub-zone consists of a broad, sandy riverbed and alluvial floodplain with a robust riparian vegetation (Figure 15) characterised by woody species such as *Faidherbia albida, Acacia erioloba, Euclea pseudebenus* (all protected species), *Tamarix usneoides* and *Salvadora persica.*



Figure 15: Riparian vegetation in the Swakop River provides essential resources such as food, shelter and nesting places for many desert organisms

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The floodplain supports many other species, including endemics and near-endemics such as *Petalidium canescens, Monechma cleomoides, Zygophyllum stapfii* and *Hermannia amabilis,* and other species, such as *Sueda plumosa*.

D.2. Valleys

The large, navigable valleys that drain into the river are scenically very appealing (Figure 16), and are characterised by *Acacia erioloba, Euphorbia virosa, Petalidium. variabile, Codon royenii* and *Zygophyllum stapfii.*



Figure 16: Scenery typical of the Swakop River and the large valleys that drain into it. These represent a potentially valuable, as yet largely untapped, source of tourism revenue for the Namib-Naukluft Park.

Recommendations – Zone D

Notwithstanding the fact that a number of protected, endemic and near-endemic plant species are found in the riverine area and attendant valleys, it is not in any particular species that the value of this zone lies, and the survival of none that were found here is threatened in any way by the project. Rather, the diverse and structured riparian vegetation of the western ephemeral watercourses in Namibia make them a priceless biological resource supporting biological productivity at every level in this extremely arid zone. The large woody species are an important food and shelter resource for animals. It is for good reason that these rivers are known as "linear oases", and **it is recommended that no mining of the river itself or the large, scenic valleys approaching it be permitted, as this would violate Article 95 of the Namibian Constitution by damaging an important ecosystem. The area north and north-east of the river in the vicinity of the Ompo deposit is of particular concern in this regard. From the river northwards to approximately 7495362N (near the turnoff presently being used to approach the Ombepo deposit) should preferably be conserved.**

These should be set aside as both biological reserves and potential areas for tourism development. They are already accessed by companies doing desert tours and are a virtually untapped resource suitable for establishment of parks facilities, hiking trails and campsites.

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Should mining be permitted, no useful mitigation measures are available beyond the prevention of unnecessary collateral damage. The species found in Zone D, with the possible exception of *Euphorbia virosa* and any *Commiphora oblanceolata* that might be present, are not suited for relocation or rescue.

In the undesirable event of deposits in this zone being mined, consideration should be given to assisting the Parks authorities to establish hiking and camping facilities elsewhere in the river to compensate for damage and activities that will limit use of the area for tourism in future.

5. OVERVIEW OF THE DEPOSITS

5.1 Anomaly A

This area includes the site designated for the plant and offices. It falls into the Zone A category, with only the very northern-most reaches impinging on Zone B. Rocky outcrops are small, and none were found to harbour species of high conservation concern. Mining of this deposit, as well as development of mine infrastructure, are not expected to have a significant impact on any plant species of conservation concern.

If possible drainage to the south should be maintained by avoiding structural developments across the larger washes (e.g. Figure 17), of which several lie in the far eastern part of the area (e.g. 0484058E, 7488359N) and one lies between the deposit and the dark koppies in the west. Note that these koppies, which lie just south of the road in the western section were not investigated, as it was indicated that they would not be impinged upon by mining activities.



Figure 17: One of the large, vegetated washes that drain through Anomaly A.

5.2 Oshiveli

At its southern end this deposit lies within Zone B (Figure 18), running north-east into Zone C. The only plant species of concern found here were *Aloe asperifolia* and *Commiphora oblanceolata*. Both are present in very low numbers, and mining of the deposit is not expected to have any significant impact on their numbers. Nevertheless, rescue and relocation could be considered.



Figure 18: Habitat typical of Zone B, seen here in the southern reaches of the Oshiveli deposit.

Although Oshiveli includes part of Zone C, it is well away from the river. Note, however, that it will probably be visible from lookout points for the moon landscape, a popular attraction in the Goanikontes area that is visited by hundreds of tourists every day.

5.3 Onkelo

This deposit lies within Zone C, but well away from the river. Mining can be expected to destroy a number of *Commiphora oblanceolata*, particularly in the more northerly section. The deposit area is small in relation to the potential area of occurrence of this species, but losses thoughout its range in the near future can confidently be predicted. See section 4.4.3 for further discussion. Mining of this deposit is not expected to have significant impacts on any other plant species of high conservation concern.

In the event of this deposit being mined, access should preferably be via the Oshiveli deposit rather than down the highly scenic valley to the east that is presently used to approach the deposit.

5.4 Ompo

Ompo falls largely within Zone C, but crosses Zone D as well. It also lies adjacent to several inhabited homesteads. Mining will result in losses of protected trees as previously listed, as well as losses of *Commiphora oblanceolata*. However losses will be relatively small, particularly of the large woody species, which all enjoy a wide distribution in Namibia, so they alone do not justify rejection of the project.

It is recommended that mining of this deposit only be permitted if it be restricted as suggested under recommendations for Zone C, i.e. at least 1 km from the river. The north-eastern corner in particular lies adjacent to a valley of great scenic beauty and possible tourism value.

5.5 Ombepo

This deposit falls into Zone C. However, the valley it lies adjacent to is not particularly scenic, and no species of conservation concern were found on the indicated area of the deposit. A single individual of *Hoodia currorii* (protected, near-endemic) was found just outside this area. Nevertheless any mining activities should not be permitted to impinge on the river.

There is a small but thriving population of *Welwitschia mirabilis* located along the approach route to this deposit (vicinity 0488547E, 7494800N). Protection of this population by careful routing of roads and strict track control would be necessary should mining proceed.

5.6 Ombuga

This deposit lies fully within Zone A. It appears to include at least one large wash, and more than one extensive rocky ridge, upon which a number of protected succulents (see discussion in section 4.4.1) were found (e.g. 0486624E, 7501004N).

In the event of this deposit being mined, drainage in the large washes should be maintained as far as possible and extensive rocky ridges should be avoided as far as is practical. Rescue and (possibly) relocation of protected succulents should be undertaken where such ridges cannot be avoided.

5.7 Rossingburg

The north-eastern extent of this deposit lies in Zone A, being a virtual continuation of the Ombuga deposit. The south-western end is composed of undulating koppies reminiscent of Zone B (Figure 19). It appears to lie just south of a very large wash, which should be conserved as far as is practical if the deposit is mined.

Figure 19: The Rossingburg deposit was found to support a low plant diversity, and is scenically unremarkable.



Here diversity is low and access is easy. No plant species of high conservation concern were found.

5.8 Anomaly B

This deposit is composed largely of Zone B type terrain, bound on several sides by high rocky ridges (Figure 20 & 21). A large, scenic valley used by tourists and harbouring the protected melon *Acanthosicyos horridus* (!nara) lies to the north and west. No plant species of high conservation concern were found in this deposit area, although *Aloe asperifolia* was observed in a gully close by.



Figures 20 & 21: Terrain at the Anomaly B deposit, which supports a low plant diversity

6. GENERAL DISCUSSION AND RECOMMENDATIONS

Due to the endemic and near-endemic plant species found in this EPL, as well as the fact that it falls within formally protected areas, it would be preferable to avoid mining it if at all possible. However, none of the species found is of excessively limited occurrence in the national sense (although obviously some, e.g. endemics, are in the global sense). Many of the endemics and near-endemics recorded from the area are annuals that produce a lot of seed and are reasonably widespread in the central Namib, making them of less concern than the perennial species, which are more dependent on specific habitats and processes, such as ephemeral washes and drainages, being maintained. Commiphoras, for instance, are slow-growing and would be unlikely to re-establish in damaged areas except in the extremely long term and even then only if the areas were rehabilitated considerably. There are, however, quite extensive areas of similar habitat outside the deposit areas where these species would continue to grow, providing that these are neither damaged during exploration, construction or mining operations, nor targeted later for further mining activity.

6.1 Damage limitation and restoration

Mining is not a sustainable activity. It usually causes permanent damage, albeit to a limited area, and in the past has already disturbed part of this site. In order to ensure that the area damaged is as limited as possible it should be emphasized that impacts such as clearing for roads and other structures on any remaining pristine or less disturbed vegetation in the direct

surrounds and outside the limits of the deposit should be minimized in the hope of later recolonisation of the habitat.

6.1.1 Location of temporary and permanent infrastructure

It is recommended that areas that are already disturbed or will definitely be disturbed in the near future be utilised for any temporary camps or construction laydown. If possible, construction teams should live off-site (e.g. in Arandis). Permanent infrastructure, such as the plant, should be planned and placed to obstruct drainage of the plain as little as possible, and to be as unobtrusive as possible.

6.1.2 Tracks

The most important mitigating action that can be taken is to ensure from the outset that roads and turning points are clearly demarcated during all phases of the operation, from exploration through construction to operation. This will ensure that no damage will be done to nondeposit areas as well as areas that might, for one reason or another, not be mined in future even although the intention at present is that they will or might be.

Although considerable effort has clearly been made to control off-road driving it is essential that a grid of roads with demarcated turning points be established within the deposit area, and that driving outside the deposit area be limited to certain tracks also. Limiting of tracks within the potential mining area is necessary because generally it cannot be predicted with any certainty that a given area will be mined and may therefore be regarded as sacrificial and unnecessary to protect. Track proliferation at Ombuga is already a problem, and needs to be addressed urgently.

6.1.3 Firewood

No collection of firewood should be permitted anywhere in the EPL during any phase of the project.

6.1.4 Restoration

Without knowing what the extent of the damage will be it is difficult to make detailed recommendations. The following are general suggestions.

Disused tracks should be rehabilitated in cooperation with the chief ranger and his staff.

Any exploration trenches where no mining will occur should be filled and contoured.

Any levelling or filling of artificially created hills or pits to restore reasonably natural contours may be expected to favour re-establishment of the original status quo regarding vegetation, and should be undertaken if economically feasible.

Establishment of a restoration trust fund consisting of a fixed percentage of profits or a given amount per weight of product should be considered.

6.1.5 Assessment and rescue missions – the role of the NBRI

Assessment of populations and losses of populations is an integral part of the Plant Red Data Assessment process. It is therefore very important that the NBRI, at their discretion, be

invited to assess the *Commiphora* population occurring in the license area so that any new applications for the area can be assessed in the light of previous population losses.

It is also recommended that the NBRI be invited to undertake a rescue mission for protected species such *as Lithops, Larryleachia, Hoodia* and *Commiphora* at their discretion.

If necessary, funding should be made available for travel and S & T expenses for NBRI staff in order to carry out these functions. Should they consider the work necessary but be unable to undertake it themselves due to staffing constraints, the work should be contracted out.

No rescue missions should be undertaken until it is firmly established exactly what areas will be affected to prevent removal of plants that would, in fact, not be affected by project activities.

6.2 Environmental responsibility

6.2.1 Monitoring

It is important that an environmental officer, with a reasonable degree of authority, be appointed early on in the project. The role of environmental manager/monitor should not be undertaken by a member of the exploration, construction or mining staff, because these roles are mutually exclusive. An outside person or one dedicated to the environmental role is necessary.

6.2.2 Penalties

During all phases of the project, but particularly during construction (when many contractors and subcontractors are usually involved), there should be contracturally set penalties in place for environmental transgressions. At all times the main contractor should be held responsible for damages, regardless of whether the damage was done by a subcontractor, in order to avoid passing of the buck.

6.2.3 Long-term monitoring

Long-term monitoring of impacts on vegetation will contribute to the rather deficient knowledge-base available for mining developments in the Namib and other arid zones. A plan for establishment and regular monitoring of permanent transects should be developed for each area to be mined prior to mining activities. Monitoring could be carried out by environmental staff on the mine.

Any rescue/relocation projects should also be subject to controlled, long-term monitoring.

7. SUMMARY OF PROJECT IMPACT ON VEGETATION

The project will have a negative impact on vegetation, and will affect populations of protected, endemic and near-endemic species. There will be contraventions of Nature Conservation Ordinance No. 4 of 1975, including amendments, and Forestry Act No. 72 of 1968. Strictly speaking permits would be required to destroy protected species, but in fact once an EIA has been passed and permission given for a project to proceed there have seldom been repercussions in this regard when permits have not been sought.

7.1 Mined areas

Within mined zones all plants will certainly be completely destroyed, and thus there will be a negative environmental impact. However this destruction of plants and their habitats should be limited to the deposit zones only, and should thus be very localised and affect only part of the license area. On a regional scale and higher it is a localised and limited impact.

Due to the nature of the activity the impact will be extremely high, and virtually all the damage will be permanent unless restoration measures are taken where possible. Even then, considerable localised damage will be long-term.

Providing that strict measures are taken to limit the area damaged as far as possible, to preserve the rest of the license area and to facilitate rescue of species of conservation concern the broader significance of the impact <u>on plants</u> (as opposed to ecosystems and scenery) in the deposit areas is low, and should not influence the decision to go ahead with the project.

DESTRUCTION OF VEGETATION	CONST	RUCTION	OPERATION		
	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation	
Extent	LIM	LIM	LIM	LIM	
Duration	Р	LT	Р	LT	
Intensity	Н	М	VH	VH	
Probability	D	D	D	D	
Significance	М	L	М	L	
Status		—	—	—	
Degree of confidence in predictions	95%	95%	95%	95%	

7.2 Construction and permanent infrastructure sites

Plants in peripheral areas such as temporary construction laydown sites and sites for permanent structures will probably also be severely damaged or lost completely, resulting in a negative environmental impact.

The extent of damage will depend upon the efforts made to restrict the area affected. The area affected could be extremely limited and localised if sufficient control is imposed. On a regional scale and higher it is a localised and limited impact.

Due to the nature of the activity the impact will be high. The damage to temporary sites will be relatively short-term while that to permanent sites will virtually be permanent unless restoration measures are taken during closure.

Providing that:

- Strict measures are taken to limit the area damaged as far as possible, to preserve the rest of the license area and to facilitate rescue of species of conservation concern.
- Serious consideration be given to landscape restoration.

the broader significance of the impact is low, and should not influence the decision to go ahead with the project.

DESTRUCTION OF VEGETATION IN	CONSTRUCTION		OPERATION	
TEMPORARY SITES	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Extent	LIM	LIM		
Duration	ST	Т		
Intensity	М	L		
Probability	D	D		
Significance	М	L	М	L
Status	_	—	—	—
Degree of confidence in predictions	95%	95%	95%	95%

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DESTRUCTION OF VEGETATION IN	CONSTRUCTION		OPERATION	
PERMANENT SITES	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Extent	LIM	LIM	LIM	LIM
Duration	Р	LT	Р	LT
Intensity	VH	Н	VH	Н
Probability	D	D	D	D
Significance	М	L	М	L
Status	—	_	—	—
Degree of confidence in predictions	95%	95%	95%	95%

7.3 License area outside the deposit zone

Impact on vegetation outside the zone of the deposit will be greatly influenced by mitigation measures taken to control collateral damage, such as that caused by vehicles. It will also be affected by decisions upon where to locate infrastructure and roads.

If collateral damage is controlled and infrastructure is sited in previously damaged areas or the area of the deposit there will be almost zero impact.

Potential impacts include damage to gravel plains and vegetation due to uncontrolled vehicle activity, siting and construction of infrastructure and removal of or damage to plants for firewood or other (e.g. ornamental) purposes.

One possible though uncertain impact would be erosion due to runoff if there were a deep pit close by.

DESTRUCTION OF VEGETATION IN	CONSTRUCTION		OPERATION	
NON-DEPOSIT AREAS	Before Mitigation	After Mitigation	Before Mitigation	After Mitigation
Extent	L	LIM	L	LIM
Duration	LT	none	LT	none
Intensity	М	none	М	none
Probability	U	U	U	U
Significance	М	L	М	L
Status	—	_	_	_
Degree of confidence in predictions	95%	95%	95%	95%

Description	The type of effect that a proposed activity will have on the environment. A narrative of the impact.
Extent	Geographic area. Whether the impact will be within a limited area (on site where construction is to take place, LIM)), locally (within the site; L), regionally (R), nationally (N) or internationally (I).
Duration	Whether the impact will be temporary (during construction only; T), short term (1-5 years; ST), medium term (5-10 years; MT), long term (longer than 10 years, but will cease after operation LT) or permanent (P).
Intensity	Quantify the magnitude of the impact and outline the method(s) used in the quantification process. Low (L) where no environmental functions and processes are affected, Moderate (M) where the environment continues to function but in a modified manner or High (H) (environmental functions and processes are altered) VH Environmental processes cease completely. May also be measured in accordance with International standards, applicable conventions, best practice policy, levels of social acceptance, etc.
Mitigation	Discusses mitigation options, and whether such options would lessen the impact to an acceptable level.
Frequency of occurrence	A description of any repetitive, continuous or time-linked characteristics of the impact(s). Continuous (C), Intermittent - occurring from time to time, without specific periodicity (I), Periodic – occurring at more or less regular intervals (P), Time-linked – occurring only or mostly at specific times of the day or week (T).
Probability	The probability that a certain impact will in fact realise; Uncertain (U), Improbable (I), Probable (P); Highly Probable (HP); Definite (D). If the probability is uncertain, then there is not sufficient information to determine its probability. Because the precautionary principle is followed, this increases the significance of the impact. Attempt to quantify the probability in statistical terms (e.g. >75% certain)
Significance	Significance is given before and after mitigation. Low if the impact will not have an influence on the decision or require to be significantly accommodated in the project design, Medium if the impact could have an influence on the environment which will require modification of the project design or alternative mitigation (the route can be used, but with deviations or mitigation) High where it could have a "no-go" implication regardless of any possible mitigation (an alternative route should be used).
Status of the impact	A statement of whether the impact is positive (a benefit), negative (a cost), or neutral. Indicate in each case who is likely to benefit and who is likely to bear the costs of each impact.
Legal requirements	An identification and list of specific legislation and permit requirements related to the specialist study that potentially could be infringed upon by the proposed project or which is required to enable the project to proceed. Reference to the proper procedures required to obtain appropriate permits should also be provided.
Degree of confidence in predictions	A statement of the degree of confidence in the predictions, based on the availability of information and the specialist's knowledge and expertise.

8. CONSTRAINTS

- Despite putting off the study until very late in the rainy season, most annual species were very immature. As a result, the study is based largely on perennial species.
- The huge area and numerous deposits involved in this EPL, as well as the late rainy season, made a comprehensive plant collection for each zone impossible. This is a baseline that should still be undertaken, possibly later this year (e.g. June) because good (but late) rains have fallen in the area.

9. DISCUSSION AND SUMMARY

It is highly likely that if mining in or near the Swakop River is permitted then Article 95 of Namibia's Constitution, providing for the maintenance of ecosystems, essential ecological processes will be violated.

Although impacts on plant species of high conservation concern will be relatively low, **it cannot be sufficiently emphasised that scenic integrity in much of the Namib-Naukluft National Park will be permanently destroyed by mining activities and the provision of services such as water and electricity to the mine/s and plant/s.**

Furthermore, the Swakop River Canyon is an area of exceptional beauty, easily on a par with the Fish River Canyon, and it holds considerable potential for further development as a tourist destination, particularly for long-distance hiking. Should mining of the river or its canyon be allowed there is no doubt that expansion of park facilities and thus tourism income to the country will be permanently compromised.

Plant 'rescue and relocation' should not be undertaken lightly, nor be seen as a "quick, highprofile fix" to lessen the impact of destruction of an area. Many 'rescued' plants do not survive, especially ones that are relocated *in situ*, and in relocating plants one often disturbs areas that would otherwise have been left untouched, potentially compromising the existing inhabitants.

10. REFERENCES

BARNARD, P. (ed.) 1998. *Biological diversity in Namibia: a country study.* Windhoek: Namibian National Biodiversity Task Force.

CRAVEN, P. (ed.) 1999. Checklist of Namibian Plant Species. *SABONET Report* No. 7. SABONET, Windhoek.

IRISH, J. 1994. Biomes of Namibia. *Navorsings van die Nasionale Museum* (South Africa). 10: 550-584.

MAGGS, G.L., CRAVEN, P. & KOLBERG, H. 1998. Plant species richness, endemism and genetic resources in Namibia. Biodiversity and Conservation 7: 435–446.

MENDELSOHN, J., Jarvis, A., Roberts, C. & Robertson, T. 2002. Atlas of Namibia. David Philip Publishers, Cape Town.

OLIVIER, J. 1995. Spatial distribution of fog in the Namib. Journal of Arid Environments 29: 129–138.

RUTHERFORD, M.C. & WESTFALL, R.H. 1986. Biomes of southern Africa – an objective categorization. *Mem. Bot. Surv. S. Afr.* 54: 1-98

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