THE SPERRGEBIET LAND USE PLAN

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Foreword

Summary

Background to the Sperrgebiet

The Sperrgebiet, or 'Forbidden Territory,' covers some 26 000 km² in south-western Namibia. Following the discovery of Namibia's first diamond near Kolmanskop in 1908, sole prospecting and mining rights were granted over an area stretching from the Orange River in the south to just north of Lüderitz, and extending 100 km inland from the coast. Although diamond mining was confined to the narrow diamondiferous strips along the coastline and Orange River, general public access to the entire licence area was prohibited except with a special permit. Thus years of diamond-related security has provided de facto preservation and today the Sperrgebiet is a pristine wilderness throughout much of its extent.

Recently, large parts of the Sperrgebiet were deproclaimed from exclusive prospecting and mining licences and the land has reverted to the status of unproclaimed State Land.

Within a regional context, the Sperrgebiet is part of what is probably one of the longest protected coastlines in the world. The entire coast, from the Iona National Park in south-western Angola to the Ramsar Site at the Orange River mouth on the boundary between Namibia and South Africa, is protected as some form of conservation area, with the exception of the Swakopmund-Walvis Bay area and the Sperrgebiet itself. Adjacent to the Sperrgebiet to the east, lies the Huns-Ai-Ais Game Reserve in Namibia and to the south of the Richtersveld National Park in South Africa. The Sperrgebiet also abuts onto some proposed marine reserves such as Ichaboe Island, Lüderitz Bay and lagoon, Halifax Island, Guano Bay, etc. It is clear that significant potential exists for a three-country international conservation area to which the Sperrgebiet forms the 'missing link'.

Furthermore, the Sperrgebiet lies at the northern end of the Succulent Karoo Biome, a biome that has been identified as a global biodiversity 'hotspot'. Only 26.8% of the original **primary** vegetation is left in the biome and only 7.8% of this is afforded formal conservation protection. Therefore the future protection of the biodiversity of the Sperrgebiet is extremely important in global terms. Thus, Namibia has an obligation to the world to protect the splendour of the Sperrgebiet. The country has taken up this challenge in a number of ways: the Namibian Constitution explicitly refers to biodiversity; it is signatory to the International Convention on Biological Diversity; and the new Namibian Policy on Conservation of Biotic Diversity and Habitat Protection recognises the link between biodiversity protection and the ability of the land to sustain peoples' livelihoods.

Added to this, is the fact that diamond mining in the Sperrgebiet is the single most important contributor to the Namibian GDP and the future Skorpion Mine will contribute another 4% to the GDP.

Background to the Land Use Plan

The overall development objective for the Sperrgebiet is to ensure the long-term sustainable economic and ecological potential of the area, with the immediate objective being that a management system for sustainable development should be established.

The restrictions on access to the Sperrgebiet not only provided *de facto* protection of the area, but it also meant that very few scientific investigations have been carried out. As a result there is a general lack of comprehensive, scientific understanding of its biodiversity to guide future development of the area.

During 1993, a number of specialists were commissioned by Namdeb to undertake studies on a wide range of environmental aspects, but even then, these studies were constrained by time and budgets and field surveys were limited. Nevertheless, this compendium of information, which has been edited into an 'Environmental Profile' of the Sperrgebiet by Pallett (1995), is still the most comprehensive source of scientific data on the Sperrgebiet and it forms the basis of the Sperrgebiet Land Use Plan. It is not the purpose of the Land Use Plan to reiterate this or other available scientific data, rather, it interprets the information in terms of the opportunities and constraints the environment affords potential land uses in the Sperrgebiet.

Development of the land use plan is the first of a three-phased process aiming towards the proclamation of the Sperrgebiet and its ultimate integration into a trans-frontier conservation area between Namibia, South Africa and Angola.

This report is part of a series of three documents, namely:

Volume 1: The Sperrgebiet Land Use Plan (this report);

Volume 2: The Meob-Conception Area Land Use Plan; and

Volume 3: A Cabinet Briefing Document in support of the proclamation of the Sperrgebiet and Meob-Conception Area as Protected Areas.

This report presents:

- An overview of the objectives and motivation for development of the land use plan;
- A brief chronological overview of the Sperrgebiet's history as a context for development of the land use plan. The report recognises the importance of the Sperrgebiet's history in shaping people's perceptions about the area. The relics of early human occupation, the captivating stories of individual and corporate entrepreneurship, hardship and fortune, and its inaccessibility during the last century, contribute to the Sperrgebiet's uniqueness and its appeal;
- An interpretation of available environmental data into:
  - a land capability assessment and relative sensitivity assessment of various parts of the Sperrgebiet; and
  - opportunities for and constraints on development in the Sperrgebiet;
- Discussion of various compatible and conflicting land uses;
- Integrated development scenarios and a zonation proposal for the Sperrgebiet;

- Management and development guidelines;

- Guidelines for each of the compatible land use options, consisting of:
  - maps showing areas of opportunity for development,
  - major activities,
  - key development requirements and inputs,
  - key development constraints,
  - key residues and emissions, and
  - issues for inclusion in an environmental assessment and management plan;

- A first phase economic analysis (desk study) of the land use recommendations in the report;

- An overview of the proposed administrative framework; and

- Appendices containing the background information to the study, the terms of reference, study approach and methodology, results of the public meetings and workshops.

Brief Summary of Recommendations

The recommendations made in this report are based on numerous inputs:

- public meetings;
- questionnaire surveys;
- one-on-one meetings with specialists;
- technical workshop with specialists;
- published and unpublished reports;
- field trips and knowledge of the area; and
- professional judgement.

The report recommends that the entire Sperrgebiet (the former Diamond Area 1), be declared a National Park under the forthcoming Namibian Parks and Wildlife Act. Nevertheless, by simply designating the Sperrgebiet as a National Park does not ensure its preservation, or its sustainable utilisation.

Proper management is crucial and recommendations for the future administration of the Sperrgebiet have been set out in the report (page 160). The challenge is to manage the wide range of environmental aspects that contributes to the area's uniqueness and appeal – the solitude, scientific and educational value, scenery, history, and the development of its natural resources (including mineral resources), in a manner that is economically viable, socially desirable and environmentally acceptable.

One of the first tools of management is to zone the area for specific land use categories. The zoning categories are based on the IUCN Management Categories, but local conditions and pre-existing land uses of the Sperrgebiet had to be acknowledged and specific guiding principles and criteria, as outlined in this report, had to be developed.

The Zoning categories, which are shown on Map 10, are summarised below:

- **Zone 1a: Strict Nature Reserve**
  These areas are to be set aside for scientific study until we know more about them, i.e. applying the precautionary principle.

- **Zone 1b: Wilderness Area**
  Low usage, core area. No, or minimal mechanised access.

- **Zone 2: National Park**
  These areas would be managed mainly for conservation and ecotourism. Here we would envisage a slightly greater public usage, but still with controlled and limited access and always with a certified guide. This zoning would allow for vehicle access and wilderness camps. We do not envisage any permanent structures to be built in this zone and only some minor upgrading of tracks and development of hiking trails. Again, parts of this zoning category can be downgraded to a '6' to allow for controlled prospecting.

- **Zone 3: Natural Monument**
  This zonation applies to the conservation of specific natural features such as the Bogenfels Arch.

- **Zone 4: Habitat / Species Management Area**
  These protected areas e.g. the Ramsar Site at the Orange River Mouth and the offshore islands should be managed mainly for conservation through management intervention e.g. manipulation of flows in the Orange River to ensure that minimum flow requirements are met.

- **Zone 5: Protected Landscape/Seascape**
  This zonation applies to areas such as the Diamond Coast Recreation Area near Lüderitz and the recreation area around Oranjemund, in which a broader spectrum of recreational activities occur and private vehicle assess is allowed.

- **Zone 6: Managed Resource Protected Area**
  This zonation allows for the area to be managed mainly for the sustainable use of natural ecosystems. While mining is not a sustainable use of resources, proper rehabilitation of these areas could mean that ultimately they would be available for some other type of land use in the future, consistent with the goals of the proposed National Park. By including these areas now into the National Park, it will allow the Government some degree of environmental control both during, and on closure of the prospecting and mining activities. Once mining ceases, the zoning of these areas could be upgraded.

Provisional mapping of zones in the Sperrgebiet and the Precautionary Principle

The entire Sperrgebiet falls in a global 'hotspot' of biological diversity – an internationally recognised global and national priority for conservation based on extreme richness and uniqueness of species. Therefore, the entire Sperrgebiet is of scientific, conservation and wilderness importance. The challenge for this land use plan is to make tentative, provisional judgements about which zones are the most sensitive from a conservation perspective, and which areas are known to be already degraded or relatively insensitive.

Many of the maps in this land use plan show, provisionally, some zones of environmental sensitivity based on current knowledge. Readers need to bear in mind that these zones are extremely preliminary. Hard-and-fast land use decisions can seldom be safely made on the basis of these maps, because so much of the Sperrgebiet is still unknown biologically. The maps should not be interpreted as showing that other zones are unimportant, or even less important. All they show is areas, which are already known to be extremely sensitive. This land use plan, written in the light of the Precautionary Principle, emphasises the provisional nature of this zoning.

The Sperrgebiet has the potential to act as a magnet for tourism in southern Namibia. The report contains recommendations to improve the Sperrgebiet's accessibility and linkages to conservation areas and tourism destinations in the region. A strong emphasis is placed on the neighbouring areas. It is envisaged that the privately owned land along the eastern boundary of the Sperrgebiet will enjoy higher densities and a greater diversity of land uses than areas inside the Sperrgebiet itself.

Rosh Pinah, Aus, Lüderitz and, in future, Oranjemund are regarded as development nodes and gateways to the Sperrgebiet. The report outlines specific development guidelines for these development nodes and for specific areas within the Sperrgebiet.

Introduction to the Land Use Plan

The Sperrgebiet is a desert: it is the 'Forbidden Territory' of Diamond Area 1 (DA1), and it has remained closed off to general public access for nearly a century. Large parts of this area have been deproclaimed from exclusive prospecting and mining licences previously owned by Namdeb. The land is now unproclaimed State land and what is to become of it? What makes the Sperrgebiet so special and why is it necessary to develop a plan for its future use?

Throughout history, Man's attitude to deserts has been ambivalent. To many, the desert was thought to be a 'blot to be reclaimed, made fertile and habitable'. In the Bible, the Lord led the Children of Israel out of the desert into plentiful country 'to eat the fruit thereof'. The desert was perceived to be an abode of bleak despair, while the desired landscape was a garden, a land of milk and honey. For Christianised Europe, the association of dry lands with mystic beauty lacked the sustenance of actual experience. The word 'desert' became synonymous with 'uninhabitable' (Tuan, 1969).

Desert hermits, perhaps first voiced an appreciation of the desert scene in itself, in the 4th Century AD. The hermits went to live in the desert, not for its beauty, but for its barrenness. The desert provided the bare, uncluttered surface on which one could give one's undivided attention to God. One such hermit, Jerome, wrote 'to me a town is a prison, and the desert loneliness a paradise.' The Bible abounds in references to the desert and the wilderness. Encounters with God, both directly and through the prophets, took place in scenes of desolation. God spoke on an empty stage, knowing how easily the sound of rivers diverted human attention (Tuan, 1969).

However, the concept that a sterile environment was a pre-requisite for spiritual purity appears to have been but a brief epoch in the growth of Christian monasticism. Monastic life reached its peak of influence and wealth in later centuries, but by then, deserts themselves had become inaccessible to Christian endeavour (Tuan, 1969). By the 19th century, the desert regained a touch of its former transcendental significance, chiefly through the works of English writers. But the need to explore the deserts was less for spiritual reasons than the more mundane pursuits of geographic intelligence and colonial expansionism. But even then, some explorers recognised that the very fact of a desert meant that it would remain 'utterly unexploitable and uninhabitable to the crack of doom' (Douglas, 1925). Douglas felt relief as he gazed into the salt depression of Chott in Tunisia; 'it pleased him that at least this little speck of the globe was irreclaimable by potato-planters for all time.'

While this may be the view of the visitor, the local inhabitant may have a completely different appreciation of the landscape he calls 'home' – one in which he needs to live and make a living; to survive in the face of adversity. Over the last century, as the population has become more mobile, the dichotomy in attitude between visitor and local inhabitant has become more pronounced. The impressions of tourists, although fleeting, cannot be ignored because of the monetary value that the tourist brings with him.

Wilderness to American settlers of the early colonial period, was viewed primarily as a threat, a place to be tamed and protected from marauding animals, Indians and demons. But by the mid 18th century, the Romantic period had seized the imagination of the growing leisure classes. A gap in environmental appreciation opened and continued to grow between the farmer who struggled against the wilderness and the cultured gentleman who appraised its scenery (Tuan, 1974).

The modern day tourist, in his air-conditioned four wheel drive, GPS and modern camping equipment will hardly be able to imagine the privations and hostile working conditions of the early miners. Scarce water, either blistering sun or cold clammy fog, persistent gale-force winds, constant sand storms and hard labour were the order of the day. Today mining and living conditions are infinitely better, but the perspectives of modern-day miners and tourists are likely to be very different.

The modern visitor's evaluation of the environment is essentially aesthetic and even spiritual, but it is an outsider's view, judged by some formal canon of beauty. But what is beauty? Even though the cliché 'beauty is in the eye of the beholder' implies that beauty is an individualistic perception, similarities in race, culture, education and fashion mean that certain generalisations can be made. Much research during the 1970s focussed on categorising and quantifying environmental quality. To Americans and north Europeans, a beautiful landscape had to contain water, mountains and trees; it had to be soft and inviting, contain no terrors of the unknown, but hold enough intrigue to pique the imagination and act as a panacea to the evils of city living. To most Euro-centric tourists, this viewpoint still persists, but to most native inhabitants, land still represents a commodity to be owned, tamed and turned into productive (agrarian) use.

This brings us to the challenge of the Sperrgebiet: a paradigm shift is required, not only by the average tourist, but by the custodians of the landscape. The majestic beauty of the desert needs to be 'found' by the tourist and preferred over the overpriced beaches of the Mediterranean, the over-traded landscapes of Europe's National Parks and the Big Five reserves of Africa. The custodians of the Sperrgebiet, the Namibian people, need to view the scenery as a resource to the community from which the whole country can benefit. As the Governor of California stated in his report on the proclamation of the Yosemite Valley as a State Park:

'It is the will of the Nation...that this scenery shall never be private property, but...it shall be held for public purposes.' (Zube, 1974, cited in Appleton, 1976).

This report will argue that the landscapes of the Sperrgebiet should be conserved in perpetuity for the benefit of the Namibian people. Furthermore, given that the area is on the list of global biodiversity 'hotspots', Namibia has an obligation to the world to protect the splendour of the Sperrgebiet.

The Need for a Land Use Plan

Although sole prospecting and mining rights were granted over the entire 30 000 km^2 area, also known more prosaically as Diamond Area 1, diamond mining was confined to a narrow coastal strip and along the banks of the Orange River. Extensive prospecting for diamonds did not reveal any diamond deposits away from these core areas.

However the exclusive licence was retained so that the intervening 100 km could act as a security buffer. Thus general public access has been denied for nearly a century. This has meant that the Sperrgebiet has effectively been preserved as a pristine wilderness throughout much of its extent. The irony is that while the area has benefited from *de facto* preservation, the same restrictions on access have meant that very few scientific investigations have been carried out.

Following the formation of Namdeb in 1994, the exclusive prospecting and mining licence priority held by CDM in the non-diamondiferous areas, was relinquished. In view of the interest in the area for a variety of uses, the Government, in consultation with Namdeb and NGOs, agreed that before the area could be opened up, a well thought-out land use plan should be formulated to guide sustainable development in the area (Hutchins, 1999).

Because of the lack of a comprehensive, scientific understanding of the biodiversity of the area, informed planning would be difficult (Kabajani, quoted in Pallett, 1995). Therefore a number of specialists were commissioned by Namdeb in 1993 to undertake studies on a wide range of environmental aspects. Even then, these studies were constrained by time and budgets and field surveys were limited. Nevertheless, this compendium of information, which has been edited into an 'Environmental Profile' of the Sperrgebiet by Pallett (1995), forms the basis of the land use plan presented in this report. We have not repeated the work here, but rather interpreted the information in terms of the opportunities and constraints the environment affords potential land use options.

The need for the land use plan is driven by the following factors:

- to protect the fragile desert, coastal and riverine environments within a development context;
- to allow sustainable development based on the inherent qualities of the area and within its carrying capacity;
- to objectively catalogue and assess all possible land use options;
- to ensure planned development according to agreed land use suitability criteria;
- to allow for integration of multiple users where practical and possible;
- to prevent unsuitable or inappropriate land use and environmental degradation caused by a lack of proper planning;
- to develop the area so that it can ultimately be integrated into the vision of a Protected Area Network spanning three countries (South Africa, Namibia and Angola); and
- to ensure that the area has a long-term benefit for the whole of Namibia, and the southern regions in particular (WEC et al., 1999).

In September 1997, a Technical Steering Committee was set up to look at the possibilities of compiling a land use plan, to draw up Terms of Reference and to secure funding. In July 1998, DANCED was approached, but a contract was only signed a year later (mid-1999) and consultants were commissioned to carry out the work, bearing in mind the following objectives:

Development Objective

- that the long-term sustainable economic and ecological potential is ensured in the Sperrgebiet.

Immediate Objective

- that a management system should be established for sustainable development of the Sperrgebiet.

Additional Objectives

- to establish an overall management and development vision for the area;
- that the Land Use Plan (LUP) be used as a guideline for the process leading to sustainable use and development of the area, as other possible land uses emerge;
- to improve the quality and standard of living of the sparse local population in and around the Sperrgebiet, by guiding the use of resources in a direction that is sustainable;
- to provide a guide for the decision-makers of Namibia and the Karas and Hardap Regions to plan and implement sustainable developments in the area; and
- to guide existing and potential future operations in the Sperrgebiet and Meob-Conception Area in the formulation of acceptable and appropriate environmental management practices and rehabilitation (MET, 1999).

This report comprises Phase 1 of a three phase process towards the proclamation of the Sperrgebiet and its ultimate integration into a Trans-frontier Conservation area between Namibia, South Africa and Angola (see Figure 1). This report, therefore, provides:

- an assessment of the land capability of the Sperrgebiet;
- an assessment of the relative sensitivity of various parts of the Sperrgebiet;
- integrated development scenarios;
- a zonation proposal;
- management and development guidelines; and
- a first phase economic analysis of various development scenarios.

Detailed development proposals will be worked out in Phase 2 and at a much larger working scale. This report provides the conceptual framework for Phase 2 and therefore mapping has been done at a very small scale.

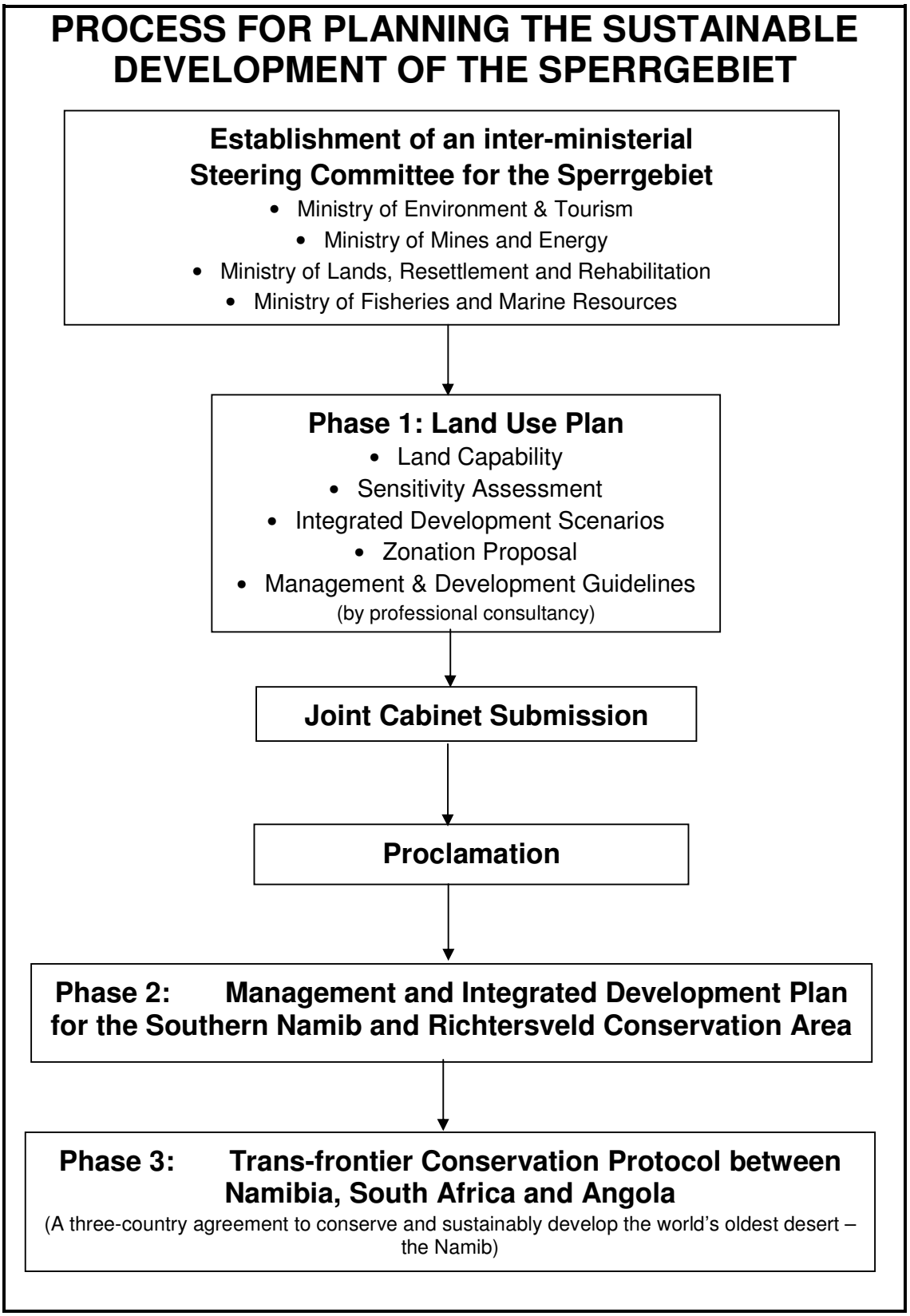

Figure 1: Process for planning the sustainable development of the Sperrgebiet

The Study Area Defined

The boundaries of the Sperrgebiet have been unclear from the outset, starting with the confusion caused by the sale by Chief Josef Fredericks of a '20 geographical mile wide coastal strip' in 1883 to Heinrich Vogelsang. Historians have since debated whether Chief Josef understood exactly the area he was selling, since a geographical mile is longer than a standard mile. Since that time there have been numerous amendments, both official and unofficial to the boundaries of the Sperrgebiet. This has resulted in errors and contradictions between the Cadastral maps of the area published by the Surveyor-General and various Government Notices.

The following list aims to highlight the discrepancies and to clarify what is included and excluded from this land use plan.

1. The boundary of Diamond Area 1 (the Sperrgebiet) is still gazetted as proceeding approximately 100 km eastwards from the coast, along the 26° S line of latitude and then heading in a southerly direction to a point on the main Lüderitz to Aus road near Aus. Although this has never been deproclaimed in the Government Gazette (pers. comm. Dr Macuvele, MME), the *de facto* boundary, as agreed by MET and CDM in 1986, runs for approximately 40 km east from the coast, up to the 15º 21' line of longitude and then due south through the Kowisberg trig. beacon to the main road. Thus the north-eastern portion of the Sperrgebiet now forms part of the Namib-Naukluft Park (NNP) (Map 1). In the LUP, this north-eastern portion is considered part of the NNP, and has been included as such in the Development Guide for the NNP. Thus the original area of the Sperrgebiet has been reduced from approximately 30 000 km^2 to 26 000 km^2.

2. While the 15º 21' E line of longitude is described as the boundary in correspondence and shown as such on maps, the recent identification of quarter degree grid squares for prospecting applications, clearly showed this boundary line to be on the 15º 30' line of longitude. For the purposes of this study the boundary will be the 15º 30' line of longitude.

3. The officially-described boundary in Schedule 1 of the Government Notice No 97 of 3 April, 2000, indicates that the DA1 boundary runs through the farm Tsirub 13. This is correctly reflected on most maps, except the 1:50 000 series, where the boundary is shown to exclude the farm Tsirub 13 from DA1. Correspondence from the owner of the farm to various government authorities as recently as 1999, clearly shows that the owner believes that the entire farm is outside DA1. The gazetted boundary (as shown on Map 1) will be taken as the official boundary.

4. The southern boundary of the Sperrgebiet will be the recognised international boundary between Namibia and South Africa.

5. The terms of reference for the LUP indicated that the western boundary of the study area should be the low water mark (LWM). This therefore excludes all surf-zone and off-shore mining activities and the offshore islands. However, mention is made in this LUP of possible future tourist linkages with some of the offshore islands and their possible proclamation as marine reserves. Furthermore, while mention is made in this document of marine biodiversity, it is solely from the point of view of **land-based** tourism opportunities.

Map 1: The Sperrgebiet

6. The Sperrgebiet, as defined in the Government Gazette, excludes the National Diamond Coast Recreation Area and the town lands of Lüderitz. Thus this area is treated in the LUP as a 'border area' – an integral, but separate part of the Sperrgebiet.

7. Oranjemund and its surrounding recreational area are part of DA1, as defined.

The boundary, as used for the purposes of this land use plan, is shown on Map 1. The entire area is 26 000 km², measuring approximately 100 km from east to west and 300 km from north to south at its greatest extent.

Place Names

This document uses names of places that are in current English-language usage, irrespective of whether the origin is German, e.g. Grossebucht, Afrikaans e.g. Van Reenenbaai, or English e.g. Roast Beef Island. The commonly adopted spellings are also used. For example, although Lüderitzbucht was anglicised by law in 1920 to Luderitz, and the law has never been amended or repealed, it is commonly spelt as 'Lüderitz' in all publications and maps. Similarly, Dias is the correct Portuguese spelling, but most references spell the word as 'Diaz'.

Historical Background

This section does not represent a comprehensive history of the Sperrgebiet[1]. Instead, by grouping the more important events in the area's history by date, it provides a quick overview of the historical context of the Sperrgebiet land use plan.

Not surprisingly, the Orange River, present-day Oranjemund and Lüderitz are among the first places to emerge from the greyness of the Sperrgebiet's early history. Then, as now, water, opportunism and diamonds are the key constraints and incentives…

Early to Late Stone Age

People have lived in the Sperrgebiet for at least 300 000 years, and possibly longer. Although the archaeological record is not continuous, the main periods are well represented. It is thought that permanent settlement by early man was unlikely and that people moved into the area following good rains, to take advantage of the bulbs, seeds and game. The coastal areas would have provided fish, whale and seal meat, seabirds, eggs and shellfish (Noli, 1999b).

More than 150 000 years ago (Early Stone Age), human occupation clustered on what is now a relict beach, close to the Orange River mouth, and four meters above the present sea level (Pallett, 1995). The river was used as a route of access to the interior.

There is some cultural artefact evidence, particularly at the Affenrücken and Chameis areas (Pallett, 1995) to suggest that human occupation continued more or less in the same area during the Middle Stone Age (from 20 000 years ago to 150 000 years ago), due to the presence of fresh water springs (Map 2 and Map 5, page 50).

During the Late Stone Age (from 20 000 years ago to 500 years ago), people were following a hunter-gatherer culture both at the coast and inland, where occupation sites tended to be associated with springs and waterholes. Artefacts from this period have been found at the Orange River mouth, Lüderitz and the Koichab River area (Pallett, 1995).

[1] That would require more extensive source research which is beyond the scope of this land use plan

Map 2: Archaeology and Palaeontology and History

(Map corrected, sources cited)

Early Adventurers and Opportunists, 1400s to 1800s

The 1400s

In 1487, the Portuguese seafarer Bartholomew Diaz set out on his journey to discover a sea route to the East. On December 24th 1487 (Budack in Schoedder et al., 1983), he landed at a place near present-day Lüderitz, and erected a cross there (Kube in Becker & Hecker, 1985) (Map 2, page 22). This is known as Diaz Point. Diaz named the bay Angra dos Ilheos (Bay of Islands), although officially, it was named Golfo de São Christovão. After rounding the Cape, Diaz was lost at sea in 1500, but his cross endured another 300 years to be seen [without its original inscription, which had by then been destroyed by wind and sand] in 1786 by Captain Thompson (Budack in Schoedder et al., 1983). In the 1800s the cross was destroyed by seal hunters who probably hoped to find buried coins. A wooden cross was erected in its place, and replaced by the present cross in 1930 (Schoedder et al., 1983).

The 1700s

Several adventurers had by now reached the southernmost parts of today's Namibia. One hunting and scientific party of 1779 included Robert Gordon, who named the large river they crossed the Orange River, in honour of the Dutch Prince of Orange (Kube in Becker & Hecker, 1985).

In 1780, a group of nomadic pastoralists (Pallett, 1995), calling themselves !Aman, crossed the Orange River and gradually occupied the area between the lower Fish River and the coast. Some of them settled at present-day Lüderitz (Budack in Schoedder et al., 1983). A map compiled by Robert Gordon at about this time, included a detailed sketch of the Khoi village at the mouth of the Orange River (Pallett, 1995). Others settled at present-day Bethanie, and one of their chiefs, Josef Fredericks, was later to play his part in the Sperrgebiet's history.

The 1800s

The London Missionary Society was the first to send missionaries to the Sperrgebiet area. Missionary Schmelen worked for long intervals between 1814 and 1828 at Klipfontein (today's Bethanie) translating the gospels into Nama (Lau, 1985). Schmelen already noted in his 1819 journal that the chief and his council at Bethanie had organized the building of a road to the port of Angra Pequena (today's Lüderitz) (Lau, 1987). This road is clearly marked on an 1894 map of German South West Africa. Missionary Bam provided in his diary of April 1884 a detailed description of the horrors of the road between Aus and Angra Pequena – sand dunes, wind, no water, drunken drivers, oxen dying on route, and the wagons constantly falling over (Bam in Vedder, ca. 1928).

In 1828, Captain Benjamin Morrell, an American, discovered the rich guano deposits on Ichaboe Island (Kube in Becker & Hecker, 1985) and by the 1840s, British merchant sailors began to exploit its high market value (Pallett, 1995). At times, more than 300 sailing ships were moored off the island, some 6000 men were scrambling over it, and more than 300 000 tons of guano were harvested (Kube in Becker & Hecker, 1985; Levinson, 1983). In the 1860s, 11 islands including Ichaboe and its neighbours were annexed by England (Kube in Becker & Hecker, 1985) to organize and protect the guano trade, and to prevent foreign interests establishing themselves there (Levinson, 1983). In 1851, Cape Town-based adventurer-trader Aaron de Pass began working the guano deposits (Levinson, 1983).

Aaron, joined by Captain John Spence, formed De Pass, Spence and Co., and signed what he considered to be a deed of sale[2] in September 1863 with Chief David Christian of the Bethaniers. The agreement granted mining rights on the coastline from Angra Pequena to Baker's Cove, and inland to 15°50' longitude, but excluded both bays (Kube in Becker & Hecker, 1985) (Map 2, page 22). On the strength of this, de Pass formed the Pomona Mining Company and tried to mine copper, silver and lead from mainland Pomona (Levinson, 1983, Schneider, 1998), but this was unsuccessful.

Bremen businessman Franz Adolf Eduard Lüderitz decided in 1882 to establish a base somewhere on the coast between the Orange River and Walvis Bay, because he expected to find minerals in the interior (Schoedder et al., 1983). He received Chancellor Bismarck's blessing for his business venture, provided that he did not interfere with the rights of others (Kube in Becker & Hecker, 1985). It is said that Bismarck himself was uninterested in acquiring for Germany what he called a 'Sandkiste' (a sand box; a child's play thing), unaware of course of the 'toys' buried in the sand.

Heinrich Vogelsang, on instructions from Lüderitz arrived at Angra Pequena in April 1883 (Kube in Becker & Hecker, 1985). In May, Vogelsang set off on foot to Bethanie to meet Chief Josef Fredericks and acquired the bay of Angra Pequena, plus five miles of ground in all directions from the bay. Payment was £100 and 200 guns. The German flag was raised for the first time at Angra Pequena on 12 May 1883 (Kube in Becker & Hecker, 1985).

On 25 August 1883, Vogelsang extended Lüderitz's business area by purchasing from Josef Fredericks[3] (for £500 in gold and 60 Wesley-Richard guns), a 20-geographical-mile-wide[4] coastal strip from the Orange River up to the 26° S latitude (Kube in Becker & Hecker, 1985).

Historians subsequently debated whether the signatories shared a common understanding of the concept 'geographical miles'. Did Josef Fredericks understand that he was actually selling a strip of land which was approximately 148 km wide, and not 20 miles (32 km) wide?

2 The word used is 'Vergunning' meaning special permission; this causes the subsequent dispute (Levinson, 1983)

3 Historical records show that the original inhabitants of the area were displaced or subjugated by successive waves of immigration from the Cape (Lan, 1982). Fredericks was certainly of the opinion that he owned the land which he inherited from his predecessor Captain David Christian. The original treaty may be seen in the National Archives. However some scholars are of the opinion that the land was not legally Frederick's to sell (Noli, 1999).

4 A German geographical mile represents 7420.44 m, which means the area 'sold' was 148 km wide.

When De Pass heard of the treaty, he protested to the British government, because he had thought he purchased land in the same area in 1863. There was a flurry of diplomatic activity between England and Germany (Levinson, 1983). In 1884 Josef Fredericks signed a declaration to the effect that the land was never actually sold to the Cape Town company and so could be sold to Adolf Lüderitz (Kube in Becker & Hecker, 1985). Two Anglo-German commissions were appointed to investigate De Pass' claims. It seemed as if a compromise was reached in 1887, in which Lüderitz retained his coastal strip with the exception of the Pomona mine and two English miles of land all around it, which were to belong to de Pass (Levinson, 1983). In fact, such was the controversy surrounding the Pomona claim, that formal extraction of the fabulously rich diamond deposits there only began in August 1912 (Levinson, 1983).

In the course of the 19th century, both the San and the Damaras who lived in the region were displaced, enslaved or exterminated by various waves of nomadic Nama herders, who had entered the area in the 17th century. Some of the surviving San resorted to a highly marginal existence in the Sperrgebiet (Noli, 1996).

The German Colonial Period, 1884-1914

Lüderitz himself landed for the first time at Angra Pequena (today's Lüderitz) in October 1883 and by 1884, he had signed, on behalf of Germany, a protection treaty with Chief Fredericks (Kube in Becker & Hecker, 1985).

One paragraph of the protection treaty conferred on Lüderitz or any company he established, the right to build roads, telegraphs and railway lines, and also to mine (Kube in Becker & Hecker, 1985). In 1885, Lüderitz sold his lands, including the mining rights, to the Deutsche Kolonialgesellschaft für Südwestafrika (the DKG: the German Colonial Company for South West Africa), (Sander, 1912; Accession 260 National Archives).

In 1886, Lüderitz, partly financed by the DKG, outfitted an expedition to explore the Orange River area. He travelled overland from Angra Pequena to the Orange River, which he sailed down in a collapsible canvas boat as far as Arrisdrift. He and his companion decided to return to Angra Pequena by sea from Alexander Bay in this boat, but somewhere along the return route, Lüderitz was lost at sea and his body was never recovered (Schoedder et al., 1983). After his death the DKG renamed Angra Pequena 'Lüderitzbucht' in his honour (Sander, 1912).

Between 1890 and 1900, Lüderitzbucht's growth was slow, and hampered by competition from Port Nolloth. Water had to be brought by sea from Cape Town. In 1898, Angra Pequena comprised six wooden/tin houses/sheds and the first town plan was established (Schoedder et al., 1983).

During the 1904-1907 Herero-Nama liberation struggle, the first troops and horses sent by Germany to the colony were shipped through Lüderitzbucht (Schoedder et al., 1983). Lüderitzbucht also became one of the centres at which large numbers of prisoners taken captive during the uprising were accommodated. Under harsh conditions, they worked on the construction of the railway line, which reached Aus in 1906 and Keetmanshoop in 1908. Many died during this time (Pool, 1979).

The military presence also brought improvements to Lüderitzbucht's infrastructure. In addition to the railway, a telephone line, Post Office and hotel were built and a business sector started to thrive.

In 1907, a German patrol found a 'San' family at Buntfeldschuh, surviving on the fountains at Buntfeldschuh, Chameis and Obib (Map 2, page 22). The patrol was told that there were six other San families living in the area. But it was not until 1931, that the police rounded up the last two groups of free-roaming hunter-gatherers of the south-western Namib in the vicinity of the Aurus Mountains, (Noli, 1999b).

The economy slowed down again markedly with the withdrawal of the troops at the end of the war in 1907 (Schoedder et al., 1983), so the discovery of diamonds could not have come at a better time…

In May 1907, August Stauch became railway station master at Grasplatz[5]. In April 1908, he registered a prospecting claim for a 10 km radius around km 24 of the Lüderitzbucht-Keetmanshoop railway line, which was valid for six months only (Schoedder et al., 1983).

In May 1908, Zacharia Lewala, who had formerly worked as a coachman in Cape Town and/or on the Kimberley mines (Namdeb, 1996; Noli, 1998; Levinson, 1983) picked up a diamond where he was working on the railway line (Schoedder et al., 1983). He reported it to his supervisor and the news was conveyed to Stauch – the Diamond Rush had begun. In that same year, from June to December, 40 000 carats of diamonds were retrieved (Kube in Becker & Hecker, 1985). Adolf Lüderitz's dreams had become reality.

By 1913, 20% of the world's output of diamonds came from the area extending from Hottentott's Bay to 25 km south of Bogenfels. Soon a large number of companies had been founded and had acquired mining rights (Schneider, 1998).

Conditions on the diamond fields were chaotic and the German Government was concerned about a number of disputes regarding overlapping mining rights, the security of the diamonds and the prevention of illegal mining. It also wanted to ensure that the German receiver of revenue would have a maximum take from the newly discovered wealth in the Schutzgebiet. Therefore on 22 September 1908, the Secretary of State proclaimed the Sperrgebiet, or prohibited area, covering the land between the Orange River in the south and latitude 26° in the north and extending inland for 100 km from the Atlantic coast. The sole mining rights in the area reverted back to the DKG (Schneider, 1998).

However, the DKG had no intention of participating directly in the mining of diamonds and in March 1909, a daughter company, the Deutsche Diamanten-Gesellschaft was founded. Together with the other mining companies, the Deutsche Diamanten-Gesellschaft soon became involved in the prospering diamond mining ventures and between 1908 and 1913 some 4.7 million carats worth more than 150 million Reichsmark, were produced (Schneider, 1998).

The actual mining and recovery process started with the excavation of the gravel using shovels. The larger companies employed electric shovels, especially for the deeper parts of the deposits. Screening to eliminate the finer fraction was carried out with swinging sieves, or 'babies', and trommel sieves. The screened material was then hand-jigged. Recovery rates using this method were low, and therefore central plants with mechanically operated concentrating devices were built (Schneider, 1998).

[5] Place of Grass, so-called because ox wagon drivers on their way to the interior usually dropped grass bales there as provision for their return journey (Levinson, 1983).

In 1909, the Koloniale Bergbaugesellschaft built a 30-km-long narrow-gauge railway line from Lüderitz to the south, on which the ore was pulled by mules. Parallel to the railway, a water pipeline and a pumpstation were installed. In 1912, a mechanised plant was commissioned, the railway was extended to 70 km and locomotives were introduced (Plate 35). In the southern part of the licence at Elizabeth Bay, ore was mined and transported by train for treatment to a plant at Kolmanskop (Schneider, 1998).

On New Year's eve 1908/1909, Stauch and Prof. Robert Scheibe[6] were on a joint expedition searching for diamonds in the Pomona area. They reached a valley which Stauch named Idatal in honour of his wife. While Stauch wandered off to establish their position relative to the coast, Scheibe started looking around, and a Herero worker known to history only as Jakob, was collecting firewood. Jakob! said Stauch jokingly on his return, 'don't look for wood, look for diamonds!' Jakob knelt down and seconds later, cried out in excitement…. There, lying on the ground, were diamonds in profusion. Jakob had found so many, he began stuffing them in his mouth for lack of carrying space, and Scheibe kept crying out 'It's a fairy-tale!' They were all too excited to sleep. Half-fearing that the diamonds would disappear, they returned in the night to where they last saw them. Now they could see them glittering in the moonlight (Levinson, 1983). Subsequent recovery methods were simple: gangs of workers crawled across the valley floor on hands and knees (Namdeb, 1996). In the first twenty months, one million carats of diamonds were mined there (Levinson, 1983).

It later transpired that their find was actually within the de Pass mining concession (Levinson, 1983; De Kok, 1936). All mining in the area was stopped while the legalities of the conflicting claims were discussed. It was only in 1912 that all claimants agreed to form the Pomona Diamanten Gesellschaft[7], and operations began. By 1914, the company was averaging 50 000 carats a month (Levinson, 1983).

Stauch set up his base at Kolmanskop[8] (Map 2, page 22). From modest beginnings of wooden buildings with corrugated iron roofs, Kolmanskop grew rapidly. In the middle of the desert, a town of handsome stone offices and homes in German architectural style emerged. There was a police station, a post office, a general dealer's store, a bakery, a butchery, a primary school and a hospital. Residents swam in the local reservoir, enjoyed live entertainment in the recreation hall, played skittles, and went on picnics.

Stauch, a major shareholder in the Pomona Diamanten Gesellschaft (Levinson, 1983), went on to make a fortune and to control millions, but in the 1930s the bubble burst - he went bankrupt and his company was liquidated.

During 1912, the DKG sent geologist Dr. Ernst Reuning to the north bank of the Orange River to prospect the coastal belt, and up the river as far as Sendelingsdrif, but after some exploration there he returned empty-handed. In October 1928, rich discoveries were made only a few hundred yards from the site of one of Reuning's digs (De Kok, 1936). Reuning was the first to hypothesize that the diamonds along the coast had been brought there from inland, along the course of the Orange River (Levinson, 1983).

6 He was from the Royal Mining Academy of Berlin (Levinson, 1983).

7 CDM acquired the rights of the Pomona Company too (De Kok, 1936).

8 It is believed to have been named after a transport driver, Johnny Kolman. Johnny, who transported goods from Keetmanshoop to Lüderitzbucht, frequently outspanned his animals and rested at the kopje (little hill) in this vicinity. In 1905, he lost his entire oxen team there in a fierce sandstorm, and he himself had to be rescued. After this, the place became known as Johnny's hill – Kolmanskuppe - later Kolmanskop (Levinson, 1983).

With Reuning on his Orange River trip, was Georg Klinghardt, who Reuning described as someone who was never happy unless he was going somewhere no-one else had been. Aptly, he named the remote Klinghardt Mountains after Klinghardt whom he described as a 'great man and idealist' (Levinson, 1983) (Map 2, page 22).

The discovery of diamonds accelerated Lüderitzbucht's development in the period 1908-1914. It received municipal status in 1909, launched its first newspaper and a stock exchange, whose member list read like a Who's Who of diamond mining, was established (Schoedder et al., 1983). More than 63 diamond companies were operating in Lüderitzbucht by 1910 (Kube in Becker & Hecker, 1985).

Entertainment included wine festivals, good food, balls, cinema, theatre and other live entertainment, torch and flag parades, skittles, billiards, shooting, horse racing, golf, gymnastics, swimming and sport festivals. Several hotels and private homes in German style were erected, among them the house of mining magnate Goerke.

The growth of the town permitted other industries to establish themselves too: machinery construction, ship-building and fishing, including lobster fishing and whaling – the Norwegians established a whaling station at Sturmvogelbucht in 1912 (Kube in Becker & Hecker, 1985). Several shipping companies such as the Woerman Line operated regular freight and passenger services to South Africa and Europe (Schoedder et al., 1983).

The coastal radio station, which later became a pretext for the South African 1914 invasion, was commissioned in June 1912 (Kube in Becker & Hecker, 1985).

The Lüderitzbucht radio station on the night of 4 August 1914 received the news that England and Germany were at war. On 7th August England conveyed to South Africa that it would consider the occupation of the radio stations[9] in German South West Africa as a service to the Empire. The South African Parliament authorised the campaign against its neighbour on September 12th (Kube in Becker & Hecker, 1985).

1914/1915 Campaign and Martial Law, 1915-1920

A night attack on the small German garrison holding the police station at Raman's Drift in mid-September 1914, followed by a seaborne invasion of Lüderitzbucht four days later, formed the spearhead of the South African attack (Kube in Becker & Hecker, 1985; L'Ange, 1991).

Captain CK de Meillon and his party entered Lüderitzbucht on the night of September 18, to find the town hastily deserted and the radio tower dynamited. A front door of one of the houses was open … inside Captain de Meillon found a pot of hot coffee on the table. Not one to miss opportunities, he finished the coffee while considering what to do next. It did not take the South Africans long to locate a store of German beer: 'dozens upon dozens of cases of it, large, beautifully long bottles of pale, cool-looking Pilsener...' (L'Ange, 1991).

The next day, the mayor of the town, Herr Kreplin, formally surrendered Lüderitzbucht while the town's German troops withdrew first to Kolmanskop and then along the railway line towards Aus pursued by the South African troops (L'Ange, 1991).

9 There was another in Windhoek; its remains can still be seen today.

German administration in the then South West Africa was terminated by the peace treaty of Khorab signed on 9 July 1915. Martial law was introduced on the same day, and the territory placed under military government (Official Gazete, 13 August 1915). On 30 October 1915, the post of Administrator, which incorporated that of Military Governor, was created (Waters, 1923). So began South African administration of the former German colony.

The Mandate Period, 1919-1989

The 1920s

During the second half of 1919, Ernest Oppenheimer, Chairman of the South African Anglo American Corporation, met with representatives of most of the larger German diamond companies in Holland (De Kok, 1936). One of the representatives was August Stauch (Levinson, 1983). With the financial backing of the Anglo American Corporation, Oppenheimer acquired for the sum of £3 500 000, the assets of ten German companies[10] and formed the Consolidated Diamond Mines of South West Africa (CDM) on 9 February 1920 (De Kok, 1936).

Despite the amalgamation of the more important diamond companies into one consolidated company, accounting for royalties and taxation proved difficult. A conference was held in 1921 between CDM, the Union Government, and the Administration of South West Africa (SWAA) to discuss the problem. Three agreements were generated, one of which is known as the Halbscheid Agreement (Otzen, 1952).

The Halbscheid Agreement confirmed that the SWAA now held the exclusive prospecting and mining rights in the Sperrgebiet. It extended this sole right for itself for a period ending not before 31 December 1970, and prohibited all prospecting and mining for any minerals within the Sperrgebiet for that period, except by CDM (Otzen, 1952). Under the Halbscheid Agreement, the SWAA undertook to re-proclaim the boundaries of the Sperrgebiet so that no uncertainties would exist as to what it included or excluded. This was done in 1922 in terms of Proclamation 35 of 1922.

Up until the twenties, diamond mining was concentrated in the central and northern part of the Sperrgebiet coast: Kolmanskop, Bogenfels, Pomona and Lüderitzbucht. During the twenties, the diamond industry enjoyed varying fortunes. In 1921, many mines closed until finally, all diamond extraction was halted. However, one year later, extraction re-commenced in Stauchslager, and at Zentralwäsche (Central Washing area). Modern machinery enabled extraction to commence at Elizabeth Bay in October 1926 (Schoedder et al., 1983).

In 1927 diamond-rich marine deposits were found at Alexander Bay, and in 1928, on the north bank of the Orange River. In 1928, the largest stone ever to be found in the then South West Africa was discovered at Oranjemund – it weighed 246½ carats (Schoedder et al., 1983). Mining of the estimated 100 km long diamond-bearing marine terrace began around 1930 on a small scale but was suspended between 1931 and 1935 during the depression. Gradually, mining activities became focussed on the marine terraces of the south, and the northern mining areas declined in importance (Namdeb, 1996).

[10] Pomona Diamanten Gesellschaft; Koloniale Bergbau Gesellschaft; Deutsche Diamanten Gesellschaft; Diamanten Pacht Gesellschaft; Diamanten Aktien Gesellschaft; Neue Hansa Diamanten Gesellschaft; Vereinigte Diamant-Minen Aktien Gesellschaft; Lüderitzbuchter Consolidierte Diamant Minen Gesellschaft; Grubenbahn Gesellschaft Pomona; Gesellschaft für Kolonial Werte (De Kok, 1936).

1930 - 1960

In 1931, De Beers Consolidated Diamond Mines Limited bought Anglo-American's interest in CDM, which became a wholly-owned subsidiary of De Beers in 1975 (Anglo American, ca. 1987).

The 1929 Wall Street stock market crash and subsequent depression years also affected the world's diamond industry and CDM. In 1930, it reduced its weekly working shifts and closed the Zentralwäsche. In April 1931, the Elizabeth Bay operation was closed, and in June 1932, CDM was forced to halt its production completely (Schoedder et al., 1983). As the depression eased, CDM was able to commence large-scale operations at Oranjemund from 1935 onwards.

Although the township of Oranjemund was established in 1936, it was not until 1943 that CDM moved its headquarters from Kolmanskop to Oranjemund. For its current (2000) population of about 10 000[11], the Company provides and operates infrastructure and services which are normally the responsibility of a local authority or the state. In 1951, the longest privately-owned bridge in the southern hemisphere, the Ernest Oppenheimer Bridge, was built across the Orange River (Namdeb, 1996). It accelerated both Oranjemund's growth and mechanisation levels in mining.

Mining operations ceased in Kolmanskop in 1950, and the last person left six years later (Levinson, 1983). Kolmanskop slowly began its transformation into a ghost town.

The provision of water to Lüderitz was, and still is, a major constraint to development of the town. As early as 1885, a sun condensator was established in Angra Pequena, which was capable of producing up to 100 litres of fresh water a day (Kube in Becker & Hecker, 1985). However by 1890, water was being brought by ship from Cape Town to supply the town's needs (Schoedder et al., 1983). There were several attempts over the years to convert seawater to drinking water, but it was not until 1969 that Lüderitz obtained a better water supply, when a well field and pipeline were constructed at Koichab, some 120 km from Lüderitz.

The 1970s and 1980s

In June 1971, the mining concession rights of CDM in the Sperrgebiet, which had been valid from 1 January 1921 until 31 December 1970, were extended for a further fifty years to 31 December 2020 (Kube in Becker & Hecker, 1985).

In 1986, the north-eastern portion of the Sperrgebiet, north of the Aus-Lüderitz road was incorporated into the Namib-Naukluft Park (Pallett, 1995). As a result, this former area of the Sperrgebiet enjoys protected status as a game reserve under the Nature Conservation Ordinance No. 4 of 1975 (MET, 2000).

[11] Personal communication, Namdeb communications officer Oranjemund.

Independence: 1990 Onwards

In November 1994, an accord was signed between the Government of Namibia and De Beers Centenary AG, which transformed CDM into the Namdeb Diamond Corporation (Pty) Ltd. (Namdeb, 1996; Namdeb, 1999). Under the 1994 accord, CDM's existing mining licences and related rights were consolidated into a renewable mineral agreement: six new mining licences, lasting initially for 25 years (Namdeb, 1996), as well as 26 exclusive prospecting licences, valid for 3 years. Namdeb's licence area represents only a portion of the original Sperrgebiet (or DA1) formerly controlled by CDM. Extensive licences were granted for offshore mining (beyond the scope of the Land Use Plan).

Both the government and Namdeb however recognized the need to prevent possible theft of diamonds from the Namdeb mining licence area. Under the Minerals Agreement 1994, it was agreed that the abandoned area should continue to be considered a prohibited area in terms of the Diamond Industry Protection Proclamation 17/1939 (MET, 2000). Policing of the abandoned area is currently undertaken by Namdeb.

The Diamond Act (Act 13 of 1999) which was promulgated in 1999, came into operation on 1 April 2000 (Government Gazettes 2205 and 2300). One of its immediate effects was to re-confirm Oranjemund's status as a high security mining zone not readily accessible to the general public. Another was to re-confirm the high security status of Namdeb's mining licence areas, thus effectively removing them from any alternative land uses in the envisaged land use plan.

Conclusion

In many different ways, the story of the Sperrgebiet has contributed to the history of Namibia – from its internal and inter-regional relationships to its historical importance in international relations. As with so much else about the Sperrgebiet, this aspect of its personality – its history – also fascinates and captivates, and contributes to the uniqueness of its spaces, places and faces.

The Sperrgebiet Environment

The Sperrgebiet environment is described and illustrated in several publications, research theses and scientific papers, most notably, Pallett, 1995. It is not the purpose of this document to reiterate this work, but rather to build on it, not through additional field surveys, but by interpreting the information in terms of the opportunities and constraints offered by the environment for various land use options. The report thus provides a planning tool; it sets the framework for all future (more detailed) planning. The sections below provide a brief overview of some of the key aspects of the Sperrgebiet environment, followed by a summary table illustrating the opportunities and constraints for various land use options.

Provisional mapping of zones in the Sperrgebiet and the Precautionary Principle

The entire Sperrgebiet falls in a global 'hotspot' of biological diversity – an internationally recognised global and national priority for conservation based on extreme richness and uniqueness of species. Therefore, the entire Sperrgebiet is of scientific, conservation and wilderness importance. The challenge for this land use plan is to make tentative, provisional judgements about which zones are the most sensitive from a conservation perspective, and which areas are known to be already degraded or relatively insensitive.

Many of the maps in this land use plan show, provisionally, some zones of environmental sensitivity. Readers need to bear in mind that these zones are extremely preliminary. Hard-and-fast land use decisions can seldom be safely made on the basis of these maps, because so much of the Sperrgebiet is still unknown biologically. The maps should not be interpreted as showing that other zones are unimportant, or even less important. All they show is areas, which are already known to be extremely sensitive. This land use plan, written in the light of the Precautionary Principle, emphasises the provisional nature of this zoning.

Climate

Wind

Strong southerly to south-westerly winds persist throughout the year, occasionally giving way to very strong north-easterly 'Berg' winds during the winter months. Calm conditions are rare, especially near the coast. Pomona has the distinction of having the highest wind velocities in southern Africa, with constant daily winds in summer ranging in velocity from 30 to 80 kph (8-22 m/s). Given that the erosion threshold for sand mobilisation is 4.4 m/s, it is clear that sand storms are a frequent occurrence.

These high velocity winds, bearing an abrasive load of sand, are responsible for sculpting the desert landscape. Bedrock has been polished bare in some of the north-easterly trending valleys north of Bogenfels, and in other places, wind erosion has resulted in strange rock sculptures (Plates 1 and 2).

While the physical manifestations of the wind regime have provided interesting landscapes and accumulations of diamonds, the practicalities are more prosaic: vehicles have to have special protective coatings to protect the paint work, glass is susceptible to sand blasting, dust affects precision instruments and machinery, and any area stripped of its protective ground cover becomes eroded.

OPPORTUNITIES	CONSTRAINTS
☐ Wind farm ☐ Board sailing in Lüderitz Bay ☐ Rapid dispersion and mixing of gaseous emissions from industrial sites	☐ Dust – all activities where the protective surface layer is disturbed ☐ Visibility during dust storms is impaired ☐ Visibility due to dust on dirt roads poses a safety hazard ☐ Sand storms are an unpleasant experience for tourists when no cover is available ☐ Sand blasting of equipment and vegetation, especially young seedlings ☐ Effects of dust on precision instruments and machinery ☐ Wind whips up salt spray along the coast, which impairs visibility and results in severe corrosion of metal, if not adequately protected ☐ Wind along the coast results in very rough seas, which affect shipping and any coastal installations

Precipitation

Most of the precipitation in the Sperrgebiet is in the form of rain and fog, but snow does occasionally occur on the mountains around Aus.

As warm air from the interior of the country meets the cold Benguela current offshore the Namibian coast, condensation causes fog to occur. Fog occurs on average for 100 days per year at Oranjemund, decreasing slightly towards Lüderitz. The fog bank tends to persist offshore and rolls inland during the evening, occasionally reaching up to 50 km inland (Map 3, page 34). The mountain ranges and inselbergs tend to attract more fog and it persists for longer over the higher ground because of the delayed dissipation of the inversion layer at altitude (pers. comm. E. Marais). The Orange River valley, however, acts as a conduit for fog to penetrate far inland. As the winds pick up during the day, the inversion layer decays and the temperature differential between land and sea decreases, which causes the fog to dissipate as the day progresses. The fauna and flora of the Sperrgebiet have developed special adaptive systems to use the fog as a source of moisture, in place of rain.

Map 3: Climate

(Amended, sources cited)

The Sperrgebiet receives less than 100 mm of rainfall per annum, which is very variable from year to year and area to area, e.g. the mountain ranges and inselbergs tend to attract slightly more precipitation than the surrounding plains due to the orographic effect. The Sperrgebiet lies in the transition zone between the winter and summer rainfall regimes of southern Africa: the northern areas fall mostly within the summer rainfall zone and the southern parts generally receive rainfall in the winter months. There is also a transition as one moves from the slightly moister eastern parts to the more arid coastal zone (Map 3, page 34). These factors combine to lend a high degree of variability in the fauna and flora of the Sperrgebiet from north to south and east to west. The rainfall variability also has a marked effect on the migration of species within the area.

Although the fog provides a valuable source of moisture for maintaining fauna and flora, rainfall is essential for plant germination. In poor rainfall years, the plants do not respond; the seeds of annual grasses do not germinate, geophytes (bulbs) do not grow and the perennial plants fail to flower. This has major implications for the food chain that is dependent on the vegetation, especially insects, birds and the larger herbivores. However, when the rains are adequate, the desert blooms and fields of grass appear, together with a mass of insects, birds and larger mammals. Herds of up to 800 gemsbok and several hundred springbok can be seen on the eastern grassy plains after good rains (Plate 3).

OPPORTUNITIES	CONSTRAINTS
☐ Highly specialised and unique flora and fauna	☐ Fog is a safety hazard on the roads due to impaired visibility
☐ Fog adds to the remote 'mood' of the desert	☐ Fog affects navigation at airports and in Lüderitz harbour
☐ Dry, sunny days are a premium for European tourists	☐ Fog could 'scavenge' pollutants from the atmosphere and deposit weak concentrations onto plants
☐ In good rainfall years, the desert in flower could be an additional tourist attraction	☐ Fog poses problems for welding during construction projects
☐ Snow on the dunes and high mountains at Aus offers a very different desert experience	☐ Lack of water in the Sperrgebiet inhibits any permanent settlement
	☐ The low amount of precipitation combined with the high annual variability prohibits any farming ventures such as dryland cropping, grazing of domestic stock or game farming
	☐ The low rainfall means that there is negligible recharge of the ground water. This means that the ground water resources are a) finite, and b) usually of poor quality
	☐ Research has to take place over several years in order to account for rainfall variability
	☐ High risk of spring flower 'show' failing

Temperature and Evaporation

Generally, the cold Atlantic currents modify the temperatures of the desert. Temperatures along the coast are usually cool due to the influence of the cold Benguela current, becoming warmer as one moves inland. In summer it can get very hot in the Orange River valley, with temperatures exceeding 40ºC. Paradoxically, some of the warmest days in the desert can occur in winter when the hot Berg winds are blowing. Irrespective of the daytime temperatures, it is always cool at night due to strong outgoing radiation under clear skies. Frost has been experienced at Aus during winter.

Evaporation is lower at the coast due to the presence of fog, but annual evaporation increases rapidly inland to over 3000 mm/annum.

OPPORTUNITIES	CONSTRAINTS
☐ Temperatures compare favourably with other parts of the Namib desert zone, and should not unduly prevent outdoor tourist pursuits ☐ Water sports in the Orange River are pleasant due to the warm temperature of the water, but close to Oranjemund, the cold air and strong winds may make some water activities unpleasant	☐ Air conditioning may be necessary in vehicles and buildings ☐ The temperature of the Orange River water in summer may be too high for some uses ☐ High ambient temperatures and high evaporation rates result in high water losses from exposed water surfaces ☐ Some methods of irrigation agriculture would require a large amount of water to overcome the high rates of evapotranspiration ☐ Evaporation from the soil surface results in a build up of salinity in the soil and surface crusting ☐ Outdoor workers may suffer from heat stress on occasion

Solar Radiation and Cloud Cover

Although no figures are available, the desert receives a high percentage of solar radiation with limited cloud cover.

OPPORTUNITIES	CONSTRAINTS
☐ Tourism (sunny, cloudless days are a premium for European tourists) ☐ Solar power generation ☐ Greenhouses/nursery for indigenous desert plants ☐ Observatory	

Geology and Landscape

The geological record of the Sperrgebiet extends back some 1 500 million years (Ma), even predating the formation of the supercontinent of Gondwanaland. The current arid period dates from 10 to 7 Ma, giving rise to the claim that the Namib is the oldest desert in the World.

The geology of the Sperrgebiet is extremely complex, and is a result of sedimentary and volcanic activity over the course of millions of years. The resulting rocks have been metamorphosed during successive stages of structural movements in the Earth's crust. The formation of extensive mineral deposits has accompanied these geological processes. Long periods of erosion by wind and water have eventually given rise to the landscape of the Sperrgebiet today.

The Namaqualand Metamorphic Complex represents the oldest rocks in the Sperrgebiet and occurs in the Lüderitz area in the northwestern part, as well as in the Aus area in the north-east. Several features of the Namaqualand Metamorphic Complex are of economic interest. In South Africa, large massive sulphide deposits occur in association with magnetitie quartzites; the iron formation in the Aus area could be of similar origin. The pre-tectonic succession has potential for metamorphosed syn-sedimentary volcano-exhalative and porphyry copper deposits. There may also be tungsten-bearing skarns in this granite-rich terrain (Miller, 1992).

The Gariep Complex forms massive outcrops in the western and south-eastern parts of the Sperrgebiet. In the east of the area, the Gariep Complex contains the lower volcano-sedimentary rocks of the Rosh Pinah Formation, which are overlain by the metasediments and limestones of the Hilda Formation, followed in turn by the Numees Formation. The Complex was intruded by granites between 500 and 600 million years ago.

The Rosh Pinah Formation is associated with extensive zinc-lead-silver-copper mineralisation. The Rosh Pinah deposit was discovered in the 1960s and mining operations started in 1969. Ore reserves were initially estimated at 2.9 Mt, but subsequent exploration has established additional ore of much higher grade. Ore reserves are sufficient for at least 15 years at current output levels, with grades of 6-7% zinc and 1-2%lead. The Skorpion Zinc Deposit, situated close to Rosh Pinah, is at an advanced stage of development, and will become one of Namibia's largest mines. The area has great potential for the discovery of similar deposits, and together with the deposits in South Africa, comprises one of the major zinc provinces in the World.

Rocks of the Nama Group occur in the eastern part of the Sperrgebiet. The Nama Group was deposited in a shallow basin and covers much of southeastern Namibia. Basal quartzites are overlain by limestones, shales and sandstones. The basal Nama quartzite may have potential for unconformity uranium deposits, where it overlies the metasediments of the Namaqualand Metamorphic Complex. Intra-Nama erosion of the limestones may have produced palaeo-karst structures into which Mississippi-Valley-type mineralisation could have been emplaced (Miller, 1992).

Over 100 small bodies of phonolite of the Klinghardt Phonolite Formation were emplaced some 37 Ma ago in the Klinghardt Mountains.

The younger succession in the Namib Desert consists of local Cretaceous deposits and extensive terrestrial Tertiary and Quarternary sediments. They are associated with raised beaches which contain the World's most extensive deposit of alluvial diamonds. Likewise, the Orange River has deposited gravels in terraces which contain diamonds in economic quantities.

The geomorphological processes at work have been likened to a gigantic sedimentary conveyor belt, which transports eroded material from the interior of the continent via the Orange River into the Atlantic Ocean.

There are two main sources of sand in the Sperrgebiet: sea-borne sediments from the Orange River Mouth; and riverine sediments deposited along the lower reaches of the river. The sediments of the Orange River appear to be a major source of sand for the main Namib Sand Sea. Some 7-15 m^3 of sand-sized sediment reaches the sea via the Orange River each year (Rogers, 1997). Vigorous long-shore drift carries this material northwards for 200 km, where much of it is deposited on the beaches of Prinzenbucht and Elizabeth Bay. It is subsequently moved inland by the strong and persistent southerly winds (Lancaster, 1990).

Map 4: Geology

The polished bedrock in the northerly-trending valleys bears witness to eons of sand-scouring (Plate 1). The sand eventually builds up into large barchan dunes south-east of Lüderitz. These rapidly-moving dunes are responsible for smothering the main road and railway line near Lüderitz. The main Sand Sea starts north of Lüderitz, comprising simple crescentic dunes inland, with compound crescentic dunes along the coast (Plate 12), (Lancaster, 1990).

Several wind tunnels exist in the south of the Sperrgebiet, which feed riverine sand from the Orange River valley into the Obib sand dunes and the central Sperrgebiet sand sheet (Plate 10). The Obib dunes are smaller and redder in colour than the main Namib Sand Sea to the north. The central Sperrgebiet sand sheet is largely stabilised with vegetation, with localised accumulations of sand on the lee of topographical obstacles.

Some of the eroded materials carried down by the Orange River were derived from the diamondiferous Kimberlite pipes found in the interior of the continent. Diamonds were subsequently deposited in ancient alluvial terraces and river channels, with some being eventually washed out to sea. These so-called marine diamonds were deposited on the ocean floor, or carried northwards on the currents and deposited along the coast, as far north as Conception Bay. These diamond deposits have provided income to generations of miners since 1908.

The mineral resources of the Sperrgebiet are not limited to diamonds. A number of geological, climatological and geomorphological circumstances over the eons have resulted in mineralisation occurring in the form of massive primary sulphides and, unusually, in secondary oxide deposits. This base metal mineralisation takes the form of lead, zinc and copper in varying proportions, with a range of minor elements. The Rosh Pinah mine extracts lead and zinc from primary sulphide deposits, while the Skorpion Zinc mine proposes to mine zinc and copper from a secondary oxide ore body. The full mineral potential of the Sperrgebiet is not known due to the fact that the entire area was under exclusive diamond mining licences. These have recently been withdrawn from parts of the Sperrgebiet and the area is now available for prospecting for base metals.

An interesting feature of the Sperrgebiet is the Roter Kamm crater. Between 4 and 3 Ma ago, the Sperrgebiet was hit by a large meteorite, forming a crater some 2.5 km across and some 150 metres deep. It is best viewed from the air, or from an elevated viewpoint, such as Aurusberg (Plate 4).

The complex geology, combined with eons of geomorphological processes and sea level fluctuations, has led to an amazing array of landscapes in the Sperrgebiet. The colour, shape, form and associated flora of each inselberg or mountain range are different, creating scenic interest at every turn (Plates 5, 6, 7 and 8). The main landscape features include:

- rocky mountains and inselbergs, each with its own unique flora;
- gravel plains (Plate 6);
- coastal salt pans in which can be found bird breeding and feeding areas, gypsum roses and halophytic flora and fauna (Plate 9);
- sand sheets and dunes, ranging from featureless landscapes to towering linear red dunes and very mobile barchan dunes (Plates 10, 11, 12 and 13);
- dry valleys hinting at wetter periods (Plate 5);
- bedrock floored valleys, which have been shaped, grooved and polished by sand-laden southerly winds (Plate 1);
- the spectacular Orange River valley as it cuts through the rugged mountains of the Richtersveld and southern Sperrgebiet (Plate 14); and
- rocky coastline, boasting the impressive rock arch at Bogenfels, interspersed with sandy bays (Plate 15).

OPPORTUNITIES	CONSTRAINTS
☐ Diamond exploration and mining	☐ The sensitivity of diamond mining together with the Diamond Act means that public access to the whole coastal zone and the stretch of Orange River in the Sperrgebiet is severely restricted. This will inhibit tourism and make any other developments unattractive due to the onerous permit requirements
☐ Base metal exploration and mining	☐ Heavy sand limits vehicle access in some places
☐ Other minerals excluding dimension stone	☐ Mobile sand dunes can interfere with tracks, roads and other infrastructure. Care needs to be taken in the siting and routing of any installations
☐ Tourism – landscapes and vistas, photography, geological interest, etc. ☐ Filming ☐ Research and education	☐ The terrain dictates the number of viable routes through the landscape

Soils

The arid climate, scant rainfall and strong winds, which move unconsolidated material, mean that the desert soils are very poorly developed. Only in sheltered basins where moisture has accumulated and a plant cover has become established, does one find some soil development. Most of the soils are thin, structureless sands, with little organic matter or clay content. In many areas, the soil is underlain by a hardpan calcrete layer.

Most of the weathering that has taken place is physical in nature (wind), rather than chemical, due to the lack of rainfall. This has resulted in the degradation of primary minerals, with little alteration of the chemical composition. This means that the soils are susceptible to salinity and sodicity and nutrient imbalances are common, brought about by the low cation exchange capacity (lack of organic material and clay minerals which enable the soils to supply and retain nutrients).

In addition to the vegetative cover, desert soils are often stabilised by either soil algae or a layer of small pebbles, known as ‘desert pavement’. These protective layers are essential to the stability of the environment, and are very susceptible to disturbance, especially by frequent pedestrian movement, vehicles and earth moving equipment. Once the protective layer has been disturbed, the underlying soil becomes available for wind erosion and dunelets form very rapidly.

The top 200 mm of the soil profile contains an immense ‘seed bank’, which in some instances, extends deeper into the soil profile. Seeds may lie dormant for many years until sufficient rainfall promotes germination. Thus the upper soil horizon is essential for maintaining a sustainable plant cover. Thus in any development that involves disturbance of the soils, it will be mandatory to strip off the top 200 mm of soil and store it separately for future use in rehabilitation.

OPPORTUNITIES	CONSTRAINTS
☐ Soil is essential for all rehabilitation programmes if correctly managed	☐ The soils are unsuitable for dryland agriculture and grazing because of the limited soil depth, high potential for salinity, sodicity, high alkalinity and low fertility. The moisture holding capacity is low and generally the soils comprise loose sands, which are unsuitable for arable and grazing use
☐ Mimic nature and use small pebbles or stones to protect soils and bare areas from wind erosion and stabilise the surface	☐ The two areas along the Orange River, which have any potential for irrigation, fall in the restricted mining area (Koeskop, Daberas), which will make access difficult. High temperatures and evaporation can lead to salinity and sodicity problems unless carefully managed
☐ Some of the alluvial soils along the Orange River have a low potential for irrigation agriculture: there is a higher percentage of silt and clay giving the soils greater structural stability and a higher moisture holding capacity. However, there are some constraints as well (see opposite column)	☐ It is patently obvious that vehicle tracks over most substrates in the Sperrgebiet last for decades. A multitude of tracks very quickly dispels the wilderness quality of the area and will lead to rapid degradation of the tourist experience. It is essential, therefore that the demarcated tracks are adhered to by all visitors to the area ☐ Exploration activities which will include tracks, grid lines, camp establishment etc. must be strictly controlled in terms of extent, and rehabilitated on closure of the site ☐ All construction activities e.g. mine development, power line and sub-station construction, fish farms, etc. will have to be strictly controlled through proper environmental planning, environmental management plans, construction monitoring and audits to ensure that soil disturbance is kept to a minimum and that soil stripping and storage is done correctly. ☐ The soils, especially near the coast are naturally quite saline and can cause corrosion of underground components e.g. pipes, concrete foundations etc. These need special protection

Surface Water

In spite of it being a desert, there are several very important components of surface water:

- Orange River;
- Orange River Mouth Wetlands;
- Coastal Salt Pans;
- Ephemeral Wetlands;
- Fountains, Springs and Seeps; and
- Atlantic Ocean.

Orange River

There is an aura associated with large rivers, especially one that flows across a continent, has a catchment exceeding one million square kilometres and flows over 2200 km from its source high in the mountains of Lesotho. It is not only these physical facts that make the Orange River special: it provides a striking visual contrast; a lush, linear oasis flowing through rugged, arid terrain (Plate 14); it has transported the diamonds that occur intermittently along its length; it is the only perennial river flowing through the arid western region for over 2000 km between the Kunene River in the north and the Olifants River to the south; the wetlands at the mouth support one of the largest water bird communities in southern Africa; and it provides a lifeline to those communities who depend on it. Without this supply of freshwater, little economic development in the Sperrgebiet and surrounding areas would have been possible (or else at great cost using imported water).

However, the economic importance of the river is reflected in the demands that have been and will be placed on its vital resources. Already the presence of several large dams upstream, together with major abstraction schemes have reduced the virgin flow of the river by 50%.

At present, Namibia is entitled to a so-called historical demand of 50 Mm^3/a, most of which is used for irrigation, with lesser amounts used for mining and domestic supply along the 500 km length of river forming the southern border of Namibia. The Department of Water Affairs (DWA) has recently negotiated an additional release of 20 Mm^3/a from South Africa to cover some of the known short-term demands, including Skorpion Zinc (pers. comm. P Heyns, DWA). Simplistically, there are two main scenarios for future water allocation in Namibia:

- Namibia will have to continue negotiating with South Africa to release additional amounts of water from the Vanderkloof dam with each new development; or
- Namibia builds a new dam on the Namibian stretch of river, with sufficient storage and yield to supply any new water demand as the DWA sees fit.

In view of the proposed land use plan set out in this report, it might be worth postulating about future water demands which were not envisaged a few years ago.

Domestic Demand

In a Department of Water Affairs (DWA) report in 1996, allowance was made for a 1.5% increase in demand by Rosh Pinah (DWA, 1996). In view of the development of the Skorpion Zinc mine, the proclamation of Rosh Pinah as a town and the proposed designation of the town as a tourism node and gateway to the Sperrgebiet (see page 73), this provision may not be sufficient in the long-term. Furthermore, there may be increased pressure on NamWater to supply tourism establishments along the eastern boundary of the Sperrgebiet, even up to the town of Aus. The land use plan envisages Aus becoming a tourism development node for the northern parts of the Sperrgebiet, but at present, ground water supplies are limited.

It is not inconceivable that Lüderitz will have to find additional water sources in the medium-term. Demand in the town is expected to rise with the expansion of the harbour, the additional tourist attractions (e.g. the waterfront and the Sperrgebiet), and the increased through flow of freight from both Skorpion and the planned Bolton Industrial fish farm in Oranjemund, to name only two new developments (see page 75). Even under present conditions, it is reported that the ground water resources at Koichab are diminishing and an alternative supply will have to be found. The only possible options are: desalination or water piped from the Naute Dam, near Keetmanshoop.

Allowance was made for a 1.5% growth of Oranjemund. This may be adequate because the planned decrease in Namdeb employees will be made up by an increase in population, if the Kudu Gas Project and/or the planned Bolton Industrial fish farm go ahead.

Industrial Demand

No allowance was made in the estimates of future Namibian demand for industrial developments, such as the Kudu Gas Power Plant and the Bolton Industrial Fish Farm. However, the site selection study for the power plant recommended that sea water rather than river water should be used for cooling purposes (WEC, 1998). Under present planning scenarios, the fish farm will only breed salt water species and will not be placing a demand on the river resources (pers. comm. P Benetto).

Mining Demand

A sufficient allocation of water has been made for all existing and likely new mining projects in the region, including the Skorpion Zinc mine, but excluding the more marginal Haib copper project further upstream. If any viable new mines are discovered in the Sperrgebiet, the amount of water required will have to be negotiated separately with DWA.

Irrigation Demand

The proposed demand for irrigation on the lower Orange River within the Sperrgebiet was calculated by DWA in 1996 to be 13.1 Mm^3/a, based on estimates of irrigable areas at Hohenfels, Koeskop and Daberas. The latter two sites are currently the subject of a full feasibility study, commissioned by MAWRD. However, since all three sites are in the restricted mining area, and the Daberas site is currently being mined, it is unlikely that there will be an additional demand for irrigation water for projects in the Sperrgebiet in the medium-term.

Ecological Demand

In addition to the consumptive demands for water described above, a team of consultants was assembled in 1996 to determine the minimum flow requirements for the Orange River mouth. Concerns had been raised that with the 50% reduction in MAR, very little water was reaching the internationally recognised Ramsar site at the mouth in some years. The report by Venter and Van Veelen (1996) indicated that an amount of 287.5 Mm^3/a is required at the mouth during normal years to ensure the long-term sustainability of the ecosystem. During drought periods (5% of the time), a total of 195.8 Mm^3/a would be required to ensure the **short-term** survival of aquatic life-forms. This of course, does not mean that reducing the MAR to the minimum levels (e.g. by water abstraction) would have no ecological consequences at the mouth.

Water Quality

The water quality of the Orange River is good, except for the generally high suspended sediment load. This means that the water needs to be clarified prior to use for domestic purposes. Silty water can also be problematic for irrigation whereby the silt can clog up sprinkler nozzles and pumps. The water will also need to be clarified for some industrial purposes such as process plants, fresh water aquaculture projects etc.

Near the mouth, the water temperature can be quite high in summer (up to 29ºC), which is unsuitable for some uses such as cooling water and aquaculture projects.

Floods

Smaller magnitude, high frequency floods are mostly contained within the upstream storage dams on the Orange River, but the larger magnitude, lower frequency floods still occur. From the records, it appears that there is a large flood event every 10 years or so, which threatens low-lying areas such as irrigated lands, the Oranjemund golf course, recreation facilities, alluvial diamond mining operations and the main Rosh Pinah to Oranjemund access road.

OPPORTUNITIES	CONSTRAINTS
☐ Good quality water except for high silt loads	☐ All river bank installations have to take into account the large magnitude flood events
☐ Allowance has been made by DWA in its negotiations for some additional demands within Namibia. With the possible development of the Sperrgebiet as a future tourist area, there will be a higher demand in future for domestic use	☐ Water needs clarifying (and sludge disposal) for many uses
☐ Irrigation agriculture	☐ The flow in the river may be reduced further depending on upstream demands
☐ Canoeing/rafting and river cruises	☐ Because the entire stretch of river in the Sperrgebiet falls under the restricted area, access to the river by tourists, farmers, researchers and other developers will be strictly limited
☐ Scenic diversity	☐ The water near the mouth may be too warm for some uses
☐ Extends range of some species far into normally hostile environments. This linear oasis has a high biological diversity which will be of interest to tourists and scientists	☐ The ecological flow requirement is sacrosanct and cannot be used consumptively by any other user
	☐ Any additional water abstraction by Namibia would have to be subject to a full EA to determine the impacts of reduced flows on the ecology of the river and mouth
☐ Diamond mining in alluvial terraces	☐ Unacceptable for mining to take place in a Ramsar Site
	☐ Any future development opportunities need to ensure that diamond security is not compromised

Orange River Mouth Wetlands

The Orange River Mouth is a listed Ramsar Site in terms of the Convention on Wetlands of International Importance Especially as Waterfowl Habitat, commonly known as the Ramsar Convention (Plate 16). South Africa became the fifth Contracting Party to the Convention in March 1975, and included the South African part of the Orange River mouth in its list of Ramsar Wetlands. Namibia became a Contracting Party in December 1995, and listed the northern bank of the Orange River mouth as a Ramsar site. The two sites cover the last 9.5 km of the Orange River at its mouth and cover approximately 2000 ha. It is the first southern African trans-boundary designated wetland site.

The South African National Report to the Ramsar Convention (1996) states that the reason why this particular wetland was designated was:

- it is an example of a specific type of wetland, rare or unusual in the appropriate biogeographical region;
- it supports an appreciable assemblage of rare, vulnerable and endangered species or subspecies of plant and animal, or an appreciable number of any one or more of these species;
- it regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity and diversity; and
- it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.'

Up to 26 000 birds, representing 56 species, have been counted in one month (December) at the Orange River mouth (Williams 1986, Simmons 1996). This makes it the sixth most important wetland in Southern Africa.

Fourteen of the species found are Namibian and South African Red Data species (e.g. Greater and Lesser Flamingos, White Pelican, Cape Cormorants, Whitebreasted Cormorants, Hartlaub's Gull, Damara Tern, Black Oystercatcher, Chestnutbanded Plover). Three of these are found in numbers exceeding 1% of their world population namely: Cape Cormorant, Damara Tern and Hartlaub's Gull (Noli-Peard & Williams 1991). In addition large roosts of common and arctic terns are frequent there.

The legal implication is that Namibia is obliged under the Ramsar Convention (Article 3.2) to inform the Convention Secretariat and South African authorities of any actual, or likely change in the ecological character of any of its listed wetlands. Accordingly if there is any abstraction from, or discharge into the river, which may have an effect on the ecological character, both countries' obligations may be affected. This applies even if water is abstracted from the river but is discharged to the sea.

Thus both the Namibian and South African Governments have a commitment to maintain the integrity of the Ramsar site at the Orange River Mouth. This has been taken up by both countries through the planning of a joint park, which will extend the conservation area up to, and including, Skilpad, some 30-35 km upstream. The proclamation of the Orange River Mouth Wetland Park (ORMWP) is expected soon.

OPPORTUNITIES	CONSTRAINTS
☐ Bird watching (special birding tours)	☐ Ecological flow requirements to maintain the Orange River mouth wetlands cannot be re-allocated to other users
☐ Sundowner cruises	☐ The ORMWP will constrain developments subject to certain conditions
☐ Scientific research in the Ramsar site due to the high levels of biological diversity	☐ The terms and conditions of the Ramsar convention and the convention for biological diversity will have to be complied with, e.g. the effects of water abstraction and disposal would have to meet strict conditions ☐ Large flocks of birds may be attracted to certain installations e.g. lights at night, aquaculture projects etc. ☐ Power lines should be routed to avoid major bird flight paths ☐ Any future development opportunities need to ensure that diamond security is not compromised

Coastal Salt Pans

Coastal salt pans are common along most of the Sperrgebiet coast from Hottentot's Bay in the north to Chameis Bay further south, occurring most often at the heads of embayments. Very few saline pans occur along the straight sandy coastline south from Chameis Bay to Oranjemund. The aptly named Pink Pan occurs near Oranjemund (Plate 9). Some of these pans are important breeding sites for the endemic and endangered Damara Tern, most notably: at Hottentot's Point, at the south end of the Lüderitz lagoon and formerly at Elizabeth Bay. The populations at the latter locality have been severely affected by the Elizabeth Bay mine, both directly through habitat disturbance and indirectly as a result of the disposal of fines into the bay which has affected the birds' food supply (Namdeb, 1997). The other wetlands provide alternative feeding grounds and 'stepping stones' as the birds migrate up and down the arid west coast of Africa.

Ephemeral Wetlands

Ephemeral wetlands comprise freshwater pans, rock pools and drainage lines. The ephemeral pans only fill with water after significant rainfall events e.g. during February 2000. The ephemeral pans in the Sperrgebiet are widely spread throughout the area, but tend to occur mostly near mountain ranges where rapid runoff from the rocky slopes accumulates at the foot of the slope e.g. at Tsaus, Aurusberg, Obibberge and the Schakalberg (Daberasvlei). Other ephemeral pans and rock pools have developed along the major drainage lines and washes and on exposed bedrock along the escarpment to the west of the Lüderitz to Oranjemund road. The low gradients and lack of defined channels mean that runoff spreads out over a wide area and slowly seeps into the sandy substrate. The most notable of these drainage lines are the Uguchab, Trekpoort, Witputs Wes, Daberas Gorge and Kaukausib drainages. Some of these drainage lines discharge into pans such as the Aurus Pan (from the Uguchab), the Anib and Arasab Pans (Plate 17). The latter two pans held water following the February 2000 rains and although the Anib Pan had dried up three months later, the Arasab Pan contained water for many months.

As a result of the widespread nature of the pans and the highly variable rainfall, wetland organisms, which cannot travel long distances in hostile environments in search of more favourable conditions, have evolved survival strategies consistent with the unpredictability of the local environment. Therefore the biology and biogeography of resident organisms, especially fauna and invertebrates, is of particular scientific interest (Breen, 1991). Several new taxa are expected to occur in these ephemeral wetlands. Threats include the removal of pan sediments or the blocking of drainage channels by road construction.

Fountains, Springs and Seeps

There are a few known fountains in the Sperrgebiet (at Chameis, Obib, Kaukausib, Daberas, Aurus, Buntfeldschuh and Grillenthal) which play an extremely valuable role in the survival of wildlife, and in the past for primitive cultures. Most of the fountains have rich deposits of archaeological and historical artefacts e.g. at Obib and Chameis Bay. The Kaukausib fountain (Plate 18) and Obib fountain are utilised by gemsbok and baboons respectively. During drought periods, animals tend to congregate around these water sources, but due to the lack of grazing in the surrounding areas, there is a high concentration of mortalities around the fountains, e.g. Kaukausib (Plate 18).

OPPORTUNITIES	CONSTRAINTS
☐ Scientific research	☐ No future developments should interfere with the Damara tern breeding sites at Hottentot's Bay and Grossebucht
☐ Archaeological research	☐ No future developments should interfere with any fountain, pan or drainage line (except for clean-up at Kaukausib)
☐ Ecological oases	☐ Any development should take into account the low frequency but high intensity storm events which lead to rapid runoff
☐ Specialist bird tours	
☐ General ecotourism	

Atlantic Ocean

The marine ecosystem of the Atlantic Ocean along the west coast of southern Africa is extremely rich due to the cold Benguela upwelling system, which brings nutrient-rich waters from great depths in the southern Atlantic. This attracts large populations of fish, seals and seabirds. However, this area which was once one of the richest fishing grounds in the world, has been over-exploited by commercial ventures over the last 30 years leading to a significant decrease in numbers of some species, such as rock lobsters (Pallett, 1995).

Between Chameis and Oranjemund, the coastline is characterised by long, straight sandy beaches interspersed with rocky headlands. From Chameis northwards, the coastal scenery becomes more interesting including such landforms as the Bogenfels Arch, Lüderitz Bay and Hottentots Point. The winds along the Sperrgebiet coast are vigorous and are predominantly from the south-westerly sector. This generates wave action far out to sea resulting in moderate to large swells (median wave height nearly 2m) reaching the coast. Under some wave conditions long-shore currents in the surf zone reach velocities of more than 1.5 m/s, compared to the velocity of off-shore coastal currents of 10-20 cm/s. The average sea temperature along the coast is cold ranging from 12 - 15°C (WEC, 1998).

The rough seas, high degree of turbulence, strong winds, swift surf-zone currents and cold water temperatures are not conducive to several recreational activities e.g. swimming, yachting, small-craft boating, sea kayaking, surfing, jetskiing and even scuba-diving (due to poor visibility).

OPPORTUNITIES	CONSTRAINTS
☐ Scenic interest, especially north of Chameis Bay, including the Bogenfels Arch	☐ Strong wave action, high degree of turbulence and long-shore currents pose problems for any coastal installations
☐ Excellent surf angling potential based on pre-determined quotas	☐ High sulphur levels increase the of corrosiveness of the water
☐ Source of water for industrial use (e.g. cooling water and aquaculture projects) and domestic use (after desalination)	☐ Cold water temperatures, high energy coastline, strong winds and frequent fog are not conducive to beach-based water sports
☐ Scientific research due to high biodiversity	☐ Any future development opportunities need to ensure that diamond security is not compromised
☐ Eco-tourism e.g. whale and dolphin watching, seal colonies, seabirds	
☐ Diamond mining	

Ground Water

Groundwater occurs in two types of aquifers: primary and secondary aquifers. Primary aquifers generally occur along major drainage lines in the valley alluvium e.g. along the Orange River, at Koichab and underlying Anib Pan (Map 5, page 50).

The primary aquifers are generally quite shallow and tend to be recharged fairly regularly by rainfall runoff or flood events along the Orange River. The water quality is therefore usually of reasonable quality, except in localised areas where the water may have come into contact with sulphide-bearing rocks.

In order to relieve the pressures of the major drought in 1951, the Government opened up a 16 km strip of land along the eastern boundary fence and 5 boreholes were drilled and equipped with diesel pumps. Each of these boreholes was drilled into a primary aquifer. The boreholes fell into disuse but the borehole infrastructure remains, with dilapidated buildings and rusty installations. Wires, corrugated iron sheeting pipes and other debris are scattered around each borehole site.

In contrast, secondary aquifers occur when the water is contained in, and moves along faults and fractures in the rock. These aquifers are usually very deep and the groundwater is often referred to as 'fossil water' due to its long residence time in the ground and the very low recharge by rainfall. As a consequence, this water is usually highly mineralised and brackish (WEC, 1999). It is not suitable for human consumption, but can be used for some other purposes, such as exploration drilling or dust suppression.

The fossil water resources are probably finite due to the low recharge and therefore any exploitation of these aquifers will effectively 'mine' the groundwater resources. Although the primary aquifers are recharged on a regular basis, if demand exceeds the rate of recharge, these aquifers can also be 'mined'. There are concerns that this is already occurring in the Koichab, which supplies water to Lüderitz. At present, groundwater supplies the following towns and villages:

- Oranjemund
  - well field in the alluvial gravel primary aquifer next to the Orange River (supply is sustainable at current levels of demand);
- Border farms e.g. Witputs
  - farm boreholes in the primary aquifer in major drainage lines (supply potential unknown and quality very variable);
- Aus
  - boreholes (limited supply potential); and
- Lüderitz
  - well field in the Koichab (demand is thought to be exceeding supply; any further growth of Lüderitz will require an alternative source of water especially for industrial use such as fish processing).

OPPORTUNITIES	CONSTRAINTS
☐ Alluvial aquifers along the Orange River have potential to supply further demands, because: □ The water is constantly recharged; □ The water quality is good □ The water is filtered and has lower suspended sediment than the river □ It is not subject to river water quotas	☐ Fossil water is not usually potable and therefore drinking water has to be imported
☐ Fossil water can provide a limited amount of water for certain purposes e.g. drilling, dust suppression etc	☐ The groundwater resources are very limited, except along the Orange River as mentioned opposite
☐ Studies need to be conducted into the need, desirability and environmental impacts of re-developing the old boreholes along the eastern fence line	☐ The re-development of the old boreholes could lead to an increased animal dependency on an artificial water supply and heavy impacts on grazing resources in a wide radius around the borehole ☐ Any abstraction of groundwater, in particular fossil water, could lower the groundwater level which would have adverse impacts on vegetation

Flora

The desert is a paradox; there are two extremes of scale: from the vastness of the landscapes, which from a distance appear to be completely barren, to the minutiae of the biota, which make it a 'living desert'. This extreme environment provides a habitat for some of the most delicate and small plants. It is a wonder of survival. Driving through these landscapes or flying over them, merely affords the viewer one dimension, albeit a spectacular one. Getting out and examining the detail provides the second dimension. The different seasons provide the third dimension, when the seemingly 'dead' landscape is transformed into a botanical wonderland during some years.

It is not by chance that this area forms part of one of the 25 global Biodiversity Hotspots, primarily on the basis of its plants (Myers, *et.al.* 2000).

The complex geology and the unique geomorphological and climatological conditions have resulted in substrates which vary considerably across the Sperrgebiet. A number of vegetation zones have been identified, each with its unique characteristics and function:

- the coastal zone;
- the central sand plains;
- rocky outcrops and inselbergs;
- lower Orange River zone.

Map 5: Groundwater Potential

(Amended; sources cited)

Coastal Zone

This comprises the area between the sea and the 300 m contour. It experiences the most fog and the strongest winds. It is characterised by plant hummocks, which form as the sand accumulates on the lee side of plants (Plate 19). The hummock vegetation is typified by tough, woody shrubs such as *Salsola nollothensis, Brownanthus namibensis* (endemic), *Amphibolia rupis-arcurtae* (endemic) and Othonna furcata. These stabilised hummocks also provide habitat for rare and endangered species such as the Namaqua dwarf adder (*Bitis schneideri*) and the desert rain frog (*Breviceps macrops*). Much of the vegetation along the seaward edge of this zone has been disturbed by diamond mining activities and only remnants of undisturbed hummock vegetation remain.

The sparse vegetation provides a degree of stability to the substrate, but where wind corridors have developed, the bare bedrock has been exposed and very little plant life occurs (Plate 1).

Lichens thrive in the cool misty conditions of the coastal zone and occur in sheltered locations, growing on a variety of substrates, such as wood, rocks and soil, while some are entirely unattached and free-living, being blown about by the wind and collecting in depressions where they respond to moisture (Pallett, 1995). The main lichen fields occur south of Chameis and on Boegoeberg (Map 6, page 53). Although knowledge about Namibia's lichens is patchy, it is internationally agreed that Namibia's lichens are unique with regard to their species richness, community diversity, fog dependence in coastal areas and the presence of unusual restricted range species (Barnard, 1998).

Lichens are easily destroyed by off-road driving and even excessive pedestrian pressure and therefore, any developments in lichen fields should be avoided.

Central Sand Plains

This vegetation zone lies between the 300 m and 600 m contours. It is characterised by low dune fields and coarse sands. The low topographic diversity and drier climatic conditions have resulted in lower plant diversity (Plate 10). Several mountainous areas and inselbergs rise up from the central sand plains e.g. Boegoeberg and the Klinghardtberge, which boast a much higher floral diversity (see below and Map 6, page 49).

Eastern Sand Plains

Most of the eastern side of the Sperrgebiet, except for the mountains, falls in this vegetation zone. The topography is more varied with a mixture of sand and gravel plains, wide drainage washes, and some permanent red dunes e.g. near Tsaus and Obib (Plates 3, 6,11). Although there is less fog here, rainfall is higher and the winds are less strong. It is therefore, a more stable environment for plant growth. Succulent plants dominate, but grasses prevail in some areas, especially after good rains. Trees are uncommon and are usually associated with ephemeral washes. The grassy plains support large herds of herbivores after rains e.g. gemsbok, springbok and ostriches.

Rocky Outcrops and Inselbergs

The mountains and inselbergs throughout the Sperrgebiet receive more rainfall and fog moisture than the surrounding plains. They also provide shelter from the wind and more shade from the sun, giving rise to a highly diverse flora (Plate 20). Most of the rare, endemic and protected species occur on the mountains and inselbergs due to the diversity of habitats found (Map 6, page 53). Another interesting feature is the relationships between certain plant species and the underlying geology. Thus the very varied geology gives rise to an equally varied flora.

The mountains and inselbergs most noted for their flora are:

- Boegoeberg (lichens),
- Tsaukhaib, Kuckaus and Tsaus (aloes, acacias, lithops, and summer rainfall flora),
- Klinghardtberge (aloes, lichens and lilies),
- Aurusberg (*Aloe ramosissima*, *A erinaceae* (Plate 21), ferns, *gladiolus* spp, orchids),
- Rooiberg (mosses, liverworts, lichens, ferns, orchids), and
- Schakalberg (ferns, mosses, orchids).

Lower Orange River

The banks of the river support dense riverine vegetation, mostly comprising trees such as *Rhus* spp., tamarix and willow (Plate 14). Although this vegetation is of no intrinsic conservation importance, it plays an important role in bank stabilisation and provides habitat for various animal species which do enjoy conservation status. Within this vegetation zone, there are some low rocky outcrops which have a specialised and rare succulent flora associated with them e.g. Skilpadberg and Swartkop.

OPPORTUNITIES	CONSTRAINTS
☐ Research	☐ Plant collectors will have to be controlled
☐ Special botanical tours	☐ Damage and loss of species could occur if new developments e.g. prospecting, mining, off-road driving etc. are not properly controlled
☐ Desert museum	☐ Trampling by too many people at view points
☐ Desert plant nursery	☐ Successful rehabilitation requires specific expertise
☐ General ecotourism	☐ Any future development opportunities need to ensure that diamond security is not compromised

Terrestrial Fauna

The Sperrgebiet lies in a transitional zone between winter and summer rainfall (south to north) and from a coastal desert to a mountainous desert (west to east). This has resulted in an extraordinary diversity in animal life for such an arid area.

Map 6: Botanical Sensitivity

(Amended; sources cited)

The south-east sector, which is adjacent to the Hunsberg, the pro-Namib, the Orange River and the Richtersveld, is particularly rich in species, although the lack of access has meant that research has been limited. Therefore the full extent of species, especially invertebrates, reptiles and arachnids is not known, although many are expected to occur and have not yet been found. It is estimated that only 66% of the possible species have been identified (Griffin, 1993). Even surveys in limited areas such as at the Skorpion Zinc project found new species of butterflies, spiders and other invertebrates, so the species numbers given for the Sperrgebiet are probably under-estimates.

Excluding birds, marine mammals and fish, 20 species are considered to be of conservation concern due to their rarity in the Sperrgebiet or their vulnerability to habitat degradation. Seven species are categorised as 'Flagship Species'[12]. Most of these species are marginal i.e. at the furthest extent of their range. The coastal hummocks, rocky habitats and the Orange River valley are the most sensitive habitats for fauna (Map 7, page 56).

Mammals

Forty-five species of terrestrial mammals have been recorded, and a further 31 plus are expected. None are true endemics to the Sperrgebiet, but seven are endemic to Namibia. The following Red Data Book species occur:

- leopard;
- aardwolf;
- brown hyaena;
- Cape fox;
- spotted hyaena;
- bat-eared fox;
- wild cat;
- cheetah; and
- Cape clawless otter.

The larger mammals include gemsbok and springbok, which are widespread throughout the area. Gemsbok congregate in large herds on the Orange River floodplain near Oranjemund and even graze the gardens of the town. After good rains, when there is sufficient grass, gemsbok and springbok are found in large herds of several hundred animals (Plate 3). Brown hyaenas are a common sight around Lüderitz. The Sperrgebiet is generally too arid for baboons and monkeys which need a regular supply of water, but there are two exceptions: baboons are found at Obib Fountain, in the Klinghardt Mountains and at Bakers Bay, while vervet monkeys live in the riverine forest along the Orange River. After good rains, when water is more freely available, baboons will range throughout the area. Other larger mammals which occur in lower numbers include: grey rhebok[13], klipspringer, steenbok and duiker.

The smaller mammals are not so obvious due to their burrowing, nocturnal nature, but large populations of rodents occur and they play a major role in the food chain for the smaller carnivores (jackals, mongooses, foxes and cats), reptiles and raptors.

Six animals are known to be locally extinct: elephant and Hartmann's mountain zebra (possibly due to the Sperrgebiet fence), and black and white rhino, giraffe and hippos due to hunting pressure in the past.

[12] Flagship species are recognised as sensitive indicators of the integrity of their habitat. Such species are not necessarily endangered, endemic or rare. Their importance lies as indicators of environmental degradation.

[13] The Sperrgebiet is thought to be the only area in Namibia where Grey rhebok have been recorded.

In spite of the harsh conditions, several alien species have taken up residence in the Sperrgebiet: European rabbit, house mouse, house rat, horses, donkeys and domestic cats. The population of house mice at Grossebucht could expand at the expense of local species and the feral donkeys along the Orange River compete for grazing with the Gemsbok. The feral cats have interbred with the African wild cat near old mining towns and the rabbits which were introduced onto Possession Island have displaced the African penguins from their breeding burrows. Apparently there are now less than 10 rabbits here and their numbers appear to be under control.

The wild horses at Garub are a significant tourist attraction (Plate 22). Although they do breed, their range is limited to a radius around artificial water points. In this area, they compete with other herbivores for grazing.

Reptiles and Amphibians

As would be expected, the desert is the preferred habitat for at least 59 species of lizard, 33 species of snake and four species of tortoise. Surprisingly, 16 species of frog occur. Many species are endemic to Namibia and some are restricted to the Sperrgebiet area, namely:

- Nama padloper;
- 2 species of skinks;
- 2 species of dwarf adders; and
- desert rain frog.

Two of these endemics (Namaqua dwarf adder and the desert rain frog) occur primarily in the coastal dune hummocks, of which only a small fragment remains due to the extensive disturbance caused by coastal diamond mining. Other preferred habitats include the rocky environments of the mountains and inselbergs, and the Orange River (Map 7, page 56).

The Flagship species of the Sperrgebiet include:

- Nama padloper;
- Namaqua dwarf adder;
- Dwarf mountain adder; and
- Desert rain frog.

The desert species which have been assigned a high conservation priority include all the Flagship species listed above, as well as:

- Coastal legless skink;
- Blind worm legless skink;
- Water leguaan;
- Namaqua rain frog;
- *Bufo robinsonii*.

Map 7: Mammals, Reptiles and Amphibians

(Amended; sources cited)

Invertebrates, Arachnids and Scorpions

As mentioned previously, the Sperrgebiet is a transitional area between biomes to the north and south, and east and west, which makes classification of the fauna, particularly the insect fauna, extremely difficult. The first major mobile dunes of the Namib Desert occur in the far southern part of the Sperrgebiet. These dunefields are known to be the genetic epicentre of the majority of the present day fauna of the Namib Biome (Map 8, page 58).

Significant linkages with adjacent biomes occur where the Huns-Richtersveld mountains intrude into the Sperrgebiet in the Rosh Pinah/Daberas/Obib area, where there are high numbers of endemic species. The Orange River also provides habitat for a distinct complex of freshwater species (Marais, 1993).

The Sperrgebiet therefore harbours a unique set of genetic material. It is a true meeting point of the insect and spider fauna of three different desert biomes (Lovegrove, 1993). Although the entomological resources of the area have been poorly studied, there is abundant evidence to support this hypothesis (Marais, 1993). Roughly 15% of the known 2400 endemic insect species of Namibia are restricted to the Sperrgebiet and its immediate surroundings, making the area the second most important zone for invertebrates in Namibia (pers. comm. E. Marais). A considerable amount of additional research is required throughout the Sperrgebiet to determine the full range of species present. For example, the relatively small study performed for the Skorpion Zinc project identified several new, undescribed species of butterflies, spiders and scorpions (E. Griffin in WEC, 2000). However, research has to take place over several years due to the strong associations between some fauna and climatic conditions; those species dependent on flowering plants, are susceptible to the vagaries of rainfall, and do not occur during low rainfall years (Marais in WEC, 2000).

Birds

Inland birds

The diversity of birds over much of the Sperrgebiet is relatively low due to the arid nature of the land and the low biomass production. Birds are highly mobile and tend to move according to the food source; peak flowering years will encourage large numbers of birds of certain species, such as coursers, bustards, korhaans, larks, chats, buntings and ostriches. The presence of larger raptors also depends on the availability of food, as they range over enormous territories, while some species of smaller raptors such as Greater Kestrels and Spotted Eagle Owls are common residents, preying upon the small mammals.

The Orange River acts as a linear oasis, allowing the movement of birds from the wetter interior to the parks and gardens of Oranjemund e.g. sunbirds, robins, thrushes etc.

Endemic species include: the Dune Lark and Gray's Lark which reach their southern limits in the northern Sperrgebiet; the newly differentiated species of lark, Barlow's Lark, which is almost entirely restricted to the Sperrgebiet; and some Cape species which reach their nothernmost extension in the Sperrgebiet, namely the Karoo Korhaan, Southern Grey Tit and Spotted Prinia. Most of these restricted range species are mobile and are not necessarily affected by small-scale developments, however, large-scale habitat alteration through e.g. overgrazing, has resulted in the local extinction of Barlow's Lark around Aus (Ryan *et al.*, 1998). Given that the range of the Barlow's Lark is now very limited and confined to the Sperrgebiet, its conservation is of great importance (Map 9, page 60).

Map 8: Invertebrates

(Amended; sources cited)

The Flagship species of the Sperrgebiet are:

- Black Eagle;
- Lappet-faced Vulture;
- Lanner Falcon;
- Peregrine Falcon;
- Karoo Korhaan;
- Ludwig's Bustard;
- Cape Francolin; and
- Malachite Sunbird.

Species of high conservation priority include the above-mentioned species, as well as:

- Tawny Eagle;
- Martial Eagle;
- Cape Eagle Owl; and
- Barlow's Lark.

Seabirds and Wetland Birds

Ten colonially-breeding species of seabirds breed at 20 different localities along the coast of the Sperrgebiet between Hottentot's Bay in the north to Oranjemund in the south (Map 9, page 60). Estimates of numbers are variable, but it is thought to be around 250 000 individuals. The most notable of these breeding species are: African Penguin[14], Cape Gannet, Cape, Bank, White Breasted and Crowned Cormorants, Hartlaub's and Kelp Gulls, Swift and Caspian Terns. The endemic Damara Tern breeds in a more dispersed fashion at four localities. Approximately 85 000 migrant seabirds of 25 species occur annually in the coastal waters, the most notable being albatrosses, petrels, prions and terns.

Some 73 species of wetland birds occur with ± 14 000 individuals. These congregate mostly at the Orange River mouth. More than 1% of the world's populations of Cape Cormorant, Hartlaub's Gull and Damara Tern occur here and it also supports more than 1% of the Southern African populations of Black-necked Grebe, Lesser Flamingo, Chestnut-banded Plover, Curlew Sandpiper, Swift Tern and Caspian Tern. The numbers have, however, declined over the last 30-40 years due to overfishing of shoaling fish, competition from seals and to a lesser extent, guano harvesting. Guano harvesting on the coastal islands, started in the 1840s as a boom industry and slowly tapered off up to the 1960s/70s. Only Ichaboe Island has sufficient annual guano production to make harvesting cost-effective.

In spite of the threats, the large bird numbers may be attributable to two main factors:
- the nutrient-rich coastal waters, and
- *de facto* protection afforded by the Sperrgebiet.

The main Flagship species of the Sperrgebiet are:

- African Penguin;
- Cape, Reed and Bank Cormorants;
- Hartlaub's Gull;
- Purple Heron;
- Fish Eagle; and
- Giant Kingfisher.

[14] The African penguin was formerly known as the Jackass penguin.

Map 9: Birds

(Amended; sources cited)

Other species of high conservation concern in addition to those listed as Flagship species are:

- Great Crested Grebe;
- White Pelican;
- Crowned Cormorant;
- Black Stork;
- Sacred Ibis;
- Greater and Lesser Flamingos;
- African Marsh Harrier;
- African Black Oystercatcher;
- Chestnut-banded Plover;
- Grey-headed Gull;
- Caspian, Swift and Damara Terns.

OPPORTUNITIES	CONSTRAINTS
☐ Scientific research – all species	☐ All developments in the Sperrgebiet will need an EA due to the highly sensitive nature of the fauna.
☐ Conservation of endemics and fulfilment of international obligations in terms of the Convention for Biological Diversity and the Ramsar Convention	☐ Certain habitats e.g. dune hummocks are of critical importance due to previous disturbance and any future developments in these habitats should be subject to a full EA and EMP
☐ Public relations benefits of finding new species	☐ Avoid all disturbance on mountains and inselbergs and rocky outcrops because of their very high ecological sensitivity
☐ Desert museum to display ecological processes, geology, fossils, artefacts, botanical specimens, arachnids, scorpions, snakes and other reptiles, small mammals, habitat types etc. It could also be used as a centre for scientific research and education	☐ Minimise or avoid activities which will destroy the stabilising riverine vegetation
☐ Specialist tours for bird watching (Ramsar site, islands, salt pans) and reptiles	☐ Bees and black fly are a serious nuisance and can cause a safety and health hazard
☐ General ecotourism e.g. game viewing, birds, whale and dolphin watching, viewing seal colonies, etc.	☐ Snakes, monkeys and baboons are a problem in camps
☐ Wild horses	☐ Hyaenas dig up rubbish and therefore all rubbish will have to be carted out to a licensed dump
☐ Re-introduction of locally extinct species e.g. black rhino, hippo, Hartmann's mountain zebra, etc.	☐ All cables have to be buried in order to protect them from crows, rats and porcupines
☐ Allow free movement of animals along traditional game corridors between the Huns Mountains and the Sperrgebiet. This would require careful consideration and strict control	☐ Crows and owls use posts as hunting perches and can rapidly foul up installations e.g. weather stations, dust sampling equipment, etc.
	☐ The restricted areas in terms of the Diamond Act (i.e. current diamond mining licence areas along the Orange River, at the mouth and along the coast) are difficult to access for research purposes and permits have to be applied for many months in advance

OPPORTUNITIES	CONSTRAINTS
	☐ Avoid using certain types of artificial light e.g. those with a high UV spectrum, because of the effects on invertebrate breeding populations. Rather use sodium vapour or yellow lights and minimise number of lights ☐ The Sperrgebiet is known as a breeding area for declared national migratory pests such as desert locusts, which may need to be monitored and controlled ☐ Strict controls will need to be applied to prevent the illegal collection of faunal components ☐ Any future development opportunities need to ensure that diamond security is not compromised

Marine Mammals

Although, this is a **land** use plan, marine mammals which frequent the coastal waters and can be seen from the land or on coastal boat tours, are included. The most common species is the Cape fur seal. Approximately half the Namibian population of seals occurs along the Sperrgebiet coast. Seals were hunted to the brink of extinction during the 1800s, but numbers have been steadily increasing since then. Major breeding colonies occur at Wolf and Atlas Bays and at North and South Long Islands. An additional two species of seals occur further out to sea.

Of the 35 species of whales and dolphins known from this part of the Atlantic, the most common species in coastal waters are:

- The Benguela, or Heaviside's dolphin, which is endemic to the south-western coast of Africa,
- whales such as Southern Right, Minke, Humpback and Killer; and
- Dusky and Bottlenose dolphins.

The Benguela dolphin is a Flagship species of the Sperrgebiet and all whales and dolphins may be regarded as having a high conservation priority.

Palaeontology

The value of the fossils lies in their contribution to our understanding of the ancient environment and how it has evolved.

The Sperrgebiet has a particularly impressive fossil record, dating from the Cretaceous period, about 85 Ma, up to the Holocene (Map 2, page 22). The richest terrestrial deposits in Africa south of the equator are located in the Sperrgebiet, at Arrisdrift on the Orange River. The fossils here date from the Miocene Era, which is generally poorly represented in southern Africa. Interesting creatures found at this site by Corvinus in the 1970s include: large hyraxes, bear-dogs, deinotheres (closely related to elephants), rhinos, crocodiles as well as smaller species such as shrews, moles and rat-like species (Pallett, 1995).

Following on from the discovery at Arrisdrift, prospecting and mining in other old meander bends of the Orange River has resulted in the discovery of fossils at Auchas and in aeolianites north of the Orange River e.g. at Rooilepel, Rooilepel West, Target Pan, Gypsum Plate Pan, Obib and Daberas (Pickford, 1993).

A palaeontological survey carried out by Pickford and Ward in the early 1990s revealed many more fossil sites e.g. at Elisabethfeld, Grillenthal, Buntfeldschuh and Fiskus (Pickford, 1993).

The Vision

Because of its inaccessibility and exciting history, the Sperrgebiet has taken on an air of mystery and romanticism. Perceptions of the Sperrgebiet vary from it being a desolate wasteland, littered with diamonds, a botanical wonderland, a small miners' paradise, the answer for all grazing woes and every tour guide's dream. It is however, all, more and none of these, depending on which part of the Sperrgebiet is in question. Many people however, have never even heard of it, even though it is the single most important contributor to the Namibian economy through diamond mining, as well as being one of the top 25 global biodiversity 'hotspots'.

The Vision for the future of the Sperrgebiet outlined below will surely put the Sperrgebiet 'on the map'.

It is recommended that the entire Sperrgebiet (former DA1), as shown on Map 1 (page 19) should be declared a Protected Area under the forthcoming Namibian Parks and Wildlife Act. This Act, which is still in draft form, will likely adopt the IUCN Guidelines for Protected Area Management Categories (IUCN, 1994). But simply designating the Sperrgebiet a Protected Area does not ensure its preservation, or allow sustainable utilisation. Management is the key: to recognise the importance of solitude, science, education, history and sustainable development without leaving a noticeable imprint, is a challenge.

One of the first tools of management is to zone the area for certain categories of land use, taking into account the following guiding principles. The Sperrgebiet represents an opportunity to show the world that conservation goals cannot be separated from economic development and that a balanced approach to sustainable development can be achieved given the political will.

Guiding Principles

The principles listed below have been adapted from those developed for the implementation of the Wilderness Act in America, to cater for the special conditions prevailing in the Sperrgebiet (McArthy-Ryan, 1996):

- Manage **all** activities so that they have a minimal impact on the environment (including ecotourism);

- allow natural processes to operate freely, except where outside resource management practices cause an impact that has to be mitigated e.g. artificial opening of the Orange River mouth, culling of seals to protect the endangered African (Jackass) Penguin colonies etc.;

- attain the highest level of naturalness. This includes restoring the wilderness character where it has been damaged by humans e.g. rehabilitation of old camps and boreholes, closing old tracks, pulling down unnecessary transmission lines and communication towers, rehabilitation of unnecessary borrow pits and recently abandoned mining and prospecting areas, removal of scrap, etc. However, many historical artefacts have an intrinsic value and should be left as part of the historical and cultural heritage.

- provide for human values and benefits while preserving the wilderness character. For example, in the Sperrgebiet, it is in the interests of all tourists that they should be accompanied at all times and that they should be restricted to a single track. Unconfined access, which is a major tenet of American wilderness experiences, is not possible in a desert environment for many reasons:

  – one set of vehicle tracks can last for decades and a multitude of tracks can quickly ruin the wilderness experience. Past experience has shown that uncontrolled vehicle access into an area will always result in a proliferation of tracks;

  – the harsh desert conditions such as heat, sun, wind, cold at night and dust storms can catch an inexperienced public unawares. Adverse health effects such as sun burn, heat stroke and dehydration are very real dangers for hikers and riders if they are not accompanied by an experienced guide;

  – heavy dune sands and steep rocky inclines require experienced 4x4 drivers and even then, vehicles can get stuck. In addition, mechanical problems such as overheating, flat tyres, breakdowns, running out of fuel etc. are real possibilities. It will be essential, therefore that vehicle access to the Sperrgebiet is with a qualified guide, who has the necessary driving skills and equipment to ensure safe travelling;

  – there will be no signage and often the tracks disappear under mobile sand dunes, or in wash-aways. Even with a GPS and maps, inexperienced drivers can easily get lost. It is therefore essential that each tour is guided by someone familiar with the area;

- reduce the physical and social impacts of human use through education, regulation and by favouring wilderness-dependent activities. Education needs to be an integral part of any wilderness management policy – not just the public, but education of the tour operators, park managers and government policy makers. Regulations are essential in the desert; e.g. the designation of tracks, campsites, rules over waste disposal, limitations on visitor numbers, mandatory guides, permits etc. Wilderness is a scarce resource and many activities proposed for the area can be practised equally well elsewhere e.g. commercial film-making, rallies, self-guided 4x4 trails, lodges, grazing etc.;

- ultimately terminate uses and activities which are not compatible with a wilderness. Land uses e.g. mining, have a statutory right and should be allowed to continue, subject to the provisions of the Policy for Prospecting and Mining in Protected Areas and National Monuments. However, by including them in the National Park, these areas will be subject to greater scrutiny and stricter rehabilitation requirements, to ensure that the land can be used for other purposes at a later date;

- accomplish the necessary park management work with the minimum tool, resorting to mechanised or motorised equipment only when its use is the least damaging to the wilderness qualities;

- plan and manage the protected area with public involvement and interdisciplinary scientific input; and

- harmonise land management activities adjacent to the protected area to provide a transition from 'pavement to primeval' and vice versa.

Wilderness or National Park?

The Sperrgebiet has the necessary attributes to qualify as a wilderness, according to the following definition:

'A wilderness, in contrast with those areas where man and his own works dominate the landscape, is recognised as an area where the earth and its community of life are untrammelled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean developed state land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural condition and which:

(1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable;

(2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation;

(3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and

(4) *may also contain ecological, geological, or other features of scientific, educational, scenic or historical value.'*

But, in order to allow for pre-existing land uses and to take into account the nature of the environment, these criteria need to be modified to suit the specific conditions of the Sperrgebiet. It is proposed that the Sperrgebiet should be proclaimed a National Park, within which we propose the following zonation, shown in Map 10, based on the IUCN Management Categories:

☐ **Zone 1a: Strict Nature Reserve**
These areas are to be set aside for scientific study until we know more about them, i.e. applying the precautionary principle.

☐ **Zone 1b: Wilderness Area**
Low usage, core area. No, or minimal mechanised access. The thinking behind this zoning category is that it is easier to downgrade a zoning category, than to upgrade it later e.g. it is easier to rezone an area from Zone 5 to Zone 6, than visa versa. Therefore we have opted for the highest wilderness category to start with.

Map 10: Zoning Map of the Sperrgebiet

(Amended)

- **Zone 2: National Park**
  These areas would be managed mainly for conservation and ecotourism. Here we would envisage a slightly greater public usage, but still with controlled and limited access and always with a certified guide. This zoning would allow for vehicle access and wilderness camps. We do not envisage any permanent structures to be built in this zone and only some minor upgrading of tracks and development of hiking trails. Again, parts of this zoning category can be downgraded to a '6' to allow for controlled prospecting.

- **Zone 3: Natural Monument**
  This zonation applies to the conservation of specific natural features such as the Bogenfels Arch.

- **Zone 4: Habitat / Species Management Area**
  These protected areas e.g. the Ramsar Site at the Orange River Mouth and the offshore islands should be managed mainly for conservation through management intervention e.g. manipulation of flows in the Orange River to ensure that minimum flow requirements are met.

- **Zone 5: Protected Landscape/Seascape**
  This zonation applies to areas such as the Diamond Coast Recreation Area near Lüderitz and the recreation area around Oranjemund, in which a broader spectrum of recreational activities occur and private vehicle assess is allowed.

- **Zone 6: Managed Resource Protected Area**
  This zonation allows for the area to be managed mainly for the sustainable use of natural ecosystems. While mining is not a sustainable use of resources, proper rehabilitation of these areas could mean that ultimately they would be available for some other type of land use in the future, consistent with the goals of the proposed National Park. By including these areas now into the National Park, it will allow the government, some degree of environmental control both during, and on closure of the prospecting and mining activities. Once mining ceases, the zoning of these areas could be upgraded.

Global Context

The Sperrgebiet lies at the northern end of the Succulent Karoo Biome (Lovegrove, 1993). This Biome has been identified as one of the 25 global hotspots of biodiversity (Myers, *et.al*. 2000). These hotspots were selected on the basis of areas with exceptional concentrations of endemic species and experiencing a high rate of habitat loss. One of the key criteria for hotspot selection was that the area must contain endemic plant species comprising at least 0.5% of all the plant species worldwide. The second main criterion for selection is that the hotspot should have lost 70% or more of its primary vegetation, this being the form of habitat that usually contains the most species, especially endemics (Myers et al., 2000).

Key statistics of the Succulent Karoo Biome

Original extent of primary vegetation in Succulent Karoo Biome	112 000 km^2
Extent of remaining primary vegetation	30 000 km^2
Percentage of original extent	26.8%
Area protected	2 352 km^2
Percentage of remaining primary vegetation which is protected	7.8%
Number of endemic plants	1 940*
Percentage of global plants	0.6%
Number of vertebrate species	472*
Number of endemic vertebrates	45*
Percentage of global vertebrates	0.2%

** Estimate only, many species in the Sperrgebiet are still undescribed.*

Since only 26.8% of the original primary vegetation is left in the Biome and only 7.8% of this is afforded any formal conservation protection, it makes the Sperrgebiet, which has enjoyed *de facto* selective protection for the last century, an extremely important area in global terms. It has been globally acknowledged that urgent action must be taken to conserve species and ecosystems to curb the increasing rate of loss of biodiversity (Glazewski *et al.*, 1998). Namibia has taken up this challenge in a number of ways.

Namibian Context

The Namibian Constitution explicitly refers to biodiversity, providing that in the interests of the welfare of the people, the State shall adopt policies aimed at maintaining ecosystems, ecological processes and biodiversity for the benefit of present and future generations (Article 95:L).

In 1992, the President of the Republic of Namibia signed the Convention on Biological Diversity (CBD) and it was ratified by Parliament in 1997. The objectives of the CBD (Article 1) are the following:

- the conservation of biological diversity,
- the sustainable use of the components of biological diversity, and
- the fair and equitable sharing of the benefits accruing from the use of such resources.

The benefits should include appropriate access to genetic resources, and appropriate transfer of relevant technologies, taking into account all rights over those resources.

The relevant articles of the CBD were incorporated into the Namibian Policy on Conservation of Biotic Diversity and Habitat Protection, which was endorsed by the Government in 1994. This Policy recognises that the loss of biodiversity will reduce stocks of natural capital, including gene pools, species richness, habitats and ecosystems and negatively alter the landscape and its ability to sustain peoples' livelihoods, as well as reducing options for future resource use, land use and development (MET, 1994). It states that all ecosystems are ultimately inter-related, thus each country, including Namibia, is responsible for the conservation/preservation of its own biotic diversity, as well as that of the global environment.

Habitat protection (Clause 3.3 of the Policy), by means of land acquisition and proclamation by the Ministry, should remain an option to enable the Ministry to legislate for a high level of environmental protection for representative samples of biotic and abiotic elements of the environment, as well as areas of conservation and scientific importance. This must be in recognition of the fact that the protection of biodiversity, ecosystems and important landscapes is of national and sometimes international importance, and that this must override local interests (Clause 3.5). However, this must be mindful of the need for economic growth and the need to improve the quality of life for all Namibians. Therefore, all development must be sustainable and must be evaluated at an appropriate level by means of Environmental Assessment procedures. This includes developments within proclaimed conservation areas (Clause 3.6).

A third commitment by the Namibian government to fulfil its obligations in terms of the CBD can be seen in the study funded by UNEP and GEF to undertake a national assessment of biodiversity in Namibia (Barnard, 1998). The study found that most Namibian endemic species are found along the Escarpment zone. Within this zone, the Succulent Karoo Biome is particularly important in terms of endemic species of succulent plants, reptiles and invertebrates. This, together with the patchy scientific knowledge of the area, has highlighted the Sperrgebiet as worthy of urgent attention at both the national and global scale (Barnard, 1998).

Regional Context

The Sperrgebiet is part of what is probably one of the longest protected coastlines in the world. The entire coastline has attained a unique level of environmental protection, partly because of the prevailing aridity of the Namib coast and the associated lack of potable water. The whole coast from the Curoca River on the northern boundary of the Iona National Park in south-western Angola to the Orange River is protected as some form of conservation area, with two exceptions:

- the Swakopmund-Walvis Bay area, and
- the Sperrgebiet, although this has received some *de facto* protection outside of the mining areas.

Adjacent to the Sperrgebiet to the east and south, lies the Huns-Ai-Ais Game Reserve in Namibia and the Richtersveld National Park (see Map 1, page 19). At the Orange River mouth, both Namibia and South Africa have had their parts of the river declared a Ramsar site in terms of the Ramsar Convention. This is the sixth most important coastal wetland for birds in southern Africa and negotiations are currently underway to form a trans-boundary Nature Reserve that will encompass the Ramsar site and other threatened habitats.

Thus the potential exists for a three-country international conservation area, covering over 1500 km of arid coast (see Map 11, page 71). The Sperrgebiet thus forms the 'missing link' in what could become the world's largest and most prestigious conservation area (MET, 1999).

The Sperrgebiet will also abut onto some of the proposed marine reserves (Mastaller, 1998), namely:

- Ichaboe Island,
- Lüderitz Bay and lagoon,
- Halifax Island and Guano Bay,
- Wolf and Atlas Bays,

Map 11: Regional Protected Area Network

(Mari to print out)

- Possession Island,
- Black Rock, Van Reenen's Bay and Bogenfels,
- Sinclair Island and Lion's Head, and
- Chameis Bay.

In order to strengthen the position of the Sperrgebiet in the regional context, it will be necessary to improve the infrastructure linkages:

- Roads
  - upgrade and tar the Aus to Rosh Pinah road,
  - proclaim and upgrade the Orange River road and improve the crossing of the Fish River,
  - re-instate the pont at Sendelingsdrift,
  - open the Mata-Mata gate at the Kalahari-Gemsbok Park border, and
  - extend the hours of the existing border posts, and reinstate the border post at Sendelingsdrift.

- Air
  - upgrade the airports at Lüderitz and Oranjemund,
  - upgrade the airstrips at Rosh Pinah and Aus,
  - install a customs post at the new Rosh Pinah airstrip.

- Train
  - provide more facilities and attractions in Aus for tourists travelling on the Shongololo Express, and
  - promote rail travel as a means of seeing the country.

- Ship
  - promote Lüderitz as a stop-over for luxury cruise ships, in addition to Walvis Bay.

Sub-regional Context

It is envisaged that the Sperrgebiet will act as a magnet for tourism in much the same way that Etosha has done for the north, or the Kruger National Park has done in Mpumalanga in South Africa. Not only do these parks generate significant incomes in their own rights, but the surrounding areas have also benefited significantly from their presence. Private nature reserves, lodges and game farms have sprung up along the southern, eastern and western borders of Etosha and along the eastern edge of the Namib-Naukluft Park (WEC, 2000). Studies have shown that there is a marked difference in income to local communities between those that are adjacent to protected areas and those that are further away (Ashley and Barnes, 1996). Not only is there a strong economic incentive for private developers to cash in on the magnet provided by such a park, but the Parks and Neighbour Relations Policy of the MET actually promotes long-term relationships between the park and local communities (WEC, 2000).

The Vision for the sub-region in the vicinity of the Sperrgebiet places a strong emphasis on the neighbouring areas. The privately owned land along the eastern boundary (Boundary Zone) of the Sperrgebiet is scenically stunning and lies within the same Biome, which contains numerous Namibian endemics, particularly flora, reptiles and invertebrates.

This Boundary Zone would experience the highest user densities and a greater diversity of land uses than inside the Sperrgebiet, depending on the options of the individual landowners. Some have already started developing lodges, hiking trails and horse safaris, for example. It is envisaged that there should be 3 to 4 Development Nodes and gateways to the Sperrgebiet: Rosh Pinah, Aus and Lüderitz (Map 10). The development of Oranjemund hinges on strategic decisions taken about its future (open up/keep closed with high security), and the implications of the Diamond Act on issues such as easy access to the town, land tenure, future mining areas and so on. It is possible that Oranjemund would only become a tourist development node after the current mining areas are deproclaimed, some time after 2020.

Rosh Pinah

Town Development

It is envisaged that Rosh Pinah will develop quite rapidly over the next few years as a result of several actual and probable factors:

- proclamation of the settlement as a town in the next two years;
- the construction and ultimate operation of the Skorpion Zinc Mine (from September 2000);
- the housing of Skorpion's employees in Rosh Pinah;
- the extended life of the Rosh Pinah mine;
- the award of exclusive prospecting licences in the Sperrgebiet to 8 companies (September 2000);
- the increasing proximity of Namdeb's diamond operations along the Orange River (Daberas, Obib and Sendelingsdrift deposits);
- tarring of the road to Aus;
- the possible re-instatement of the pont at Sendelingsdrift;
- the construction of a safer airstrip, which may have a customs post;
- strengthening of power, telecommunication and water supplies due to the development of Skorpion;
- significant increase in tourism due to the presence of the Sperrgebiet National Park and an Entrance Gate near Rosh Pinah; and
- greater circulation of tourists throughout the Region due to the future Huns-Ai-Ais/Richtersveld trans-frontier park.

In response to these developments, it is expected that there will be scope for the following facilities, amenities and services:

- hotel(s) and lodge(s);
- bed and breakfast establishments;
- restaurants;
- campsites;
- tour operators;
- outfitters for hiking, horse and camel trails, camping etc.;
- wilderness training school;
- shops, banks, post office, garages and workshops;
- desert museum;
- observatory;
- golf and other recreation facilities;
- river rafting/canoeing end point.

Development within the Sperrgebiet near Rosh Pinah

Within the Sperrgebiet near Rosh Pinah, there is considerable potential for a number of tourist activities. This area is scenically attractive, boasts carpets of flowers in good years and has more larger game than elsewhere in the Sperrgebiet (Plates 2, 3, 4, 8, 23 and 24). This south-eastern corner also has a wide range of landscape types, from rugged mountains, to grassy plains, to red mobile dunes. Added attractions include the Obib fountain, Roter Kamm, archaeological artefacts and the Skorpion Zinc Mine. The large meanders of the Orange River which wind through extremely rugged environments, with views across the river to the Richtersveld, offer unparalleled tourist opportunities, but access to this section of the river will require permits in terms of the Diamond Act and will prohibit most tourists (Plate 25). Some of the activities that would be consistent with the land use plan zoning for this area include:

- Guided hikes (Zones 1b, 2, 3 and 5)
  - These would comprise one to two day hikes, the length being constrained by the lack of water, since access through the Sperrgebiet to the Orange River will not be possible due to mining. Thus hikers will have to pack everything, including water, in and out. Wilderness camps will be permitted, but all waste will have to be removed and no permanent structures such as long-drops, picnic tables, braai sites etc. will be allowed. Alternatively a campsite could be established on the river just outside the Sperrgebiet, where more permanent infrastructure could be provided. The maximum number of people per trail would be determined in the Park Management Plan (Phase 2).

- Guided horse trails (Zones 1b and 2)
  - Again, the length of these trails will be constrained by lack of water for the horses, which need to drink regularly, and therefore only half-day and one day trails will be possible, unless a point of access is allowed through the fence to reach the river, just outside the Sperrgebiet. Details will be worked out in the detailed Park Management Plan (Phase 2).

- Guided camel safaris (Zones 1b and 2)
  - Camels can survive for several days without water and therefore, camel safaris may be a more realistic alternative form of touring in the Sperrgebiet. Water and other supplies can be transported by camel for the duration of the tour. Overnight accommodation will be in wilderness camps, with the same provisions as described for hiking above.

- Guided 4x4 drives (Zone 2 only)
  - Because of the sensitivity and hostile nature of the environment and the long-lasting nature of vehicle tracks, it would not be in the interests of long-term sustainability to allow unguided vehicle access. Therefore, all access will be in a guided tour, using either the tour operator's vehicles and drivers, or self-driven vehicles following a guide. The number of vehicles in any tour will be limited to say 3-4 and the number of tours per week will also be limited. The exact details will have to be worked out in the detailed Park Management Plan (Phase 2). These tours could have a duration of half-day to two days, staying overnight in wilderness camps. Again all water and supplies will have to be transported in and all waste carried out. It may be necessary to provide a portable toilet in the lead vehicle to prevent a build up of human waste at each viewpoint and camp site.[15] The exact routes for the 4x4 trails will be developed in the Park Management Plan, and the tour operators will be expected to stay on the tracks at all times.

[15] This aspect needs to be taken seriously in order to avoid the pollution problems that are now evident on Kilamanjaro, and in certain places in the Richtersveld and Savuti National Park.

- Guided special interest tours (Zones 1b, 3, 4 and 5)
  - As noted in this report, the area is extremely well-endowed with rare and endemic species of plants, invertebrates, reptiles etc, which would appeal to professionals and amateur enthusiasts alike, especially during the flowering season. There are also interesting archaeological and historical sites and geological exposures which would be of interest to some throughout the year e.g. Roter Kamm. This part of the Sperrgebiet also lends itself to photography and specialist photographic tours would be popular, especially during flower season, when many photographers are attracted to Namaqualand, just south of the Sperrgebiet. These tours could be a combination of 4x4 and hiking and would be subject to the same restrictions as noted above.

- Skorpion mine tours (Zones 2 and 6)
  - A bus full of tourists visits the Rössing Uranium Mine every week to look in awe at the open pit and gasp at the size of the mobile equipment. Skorpion could also encourage tourists to visit the mine, where they could promote issues such as sound environmental planning, zero effluent emission, water conservation measures, rehabilitation techniques and the plant rescue operations. People could learn about base metals and the whole extraction and beneficiation process. Samples of ore and the refined products (zinc and copper) could be displayed, along with an explanation of their use in everyday life.

- Prospecting
  - There is a high degree of prospectivity for base metals in the Sperrgebiet in the vicinity of Rosh Pinah, which has been heightened by the success of the Skorpion prospect.

Development within the Boundary Zone

In the Boundary Zone, adjacent to the Sperrgebiet's eastern boundary, it may be possible to pursue a number of activities such as:

- Hot air ballooning,
- 4x4 self-guided trails,
- Hunting,
- Game farming,
- Mountain biking trails,
- Prospecting,
- Mining,
- Tourist lodges offering a range of activities,
- Biodiversity research institute.

These activities would all be on private farms, which could potentially be integrated into a conservancy (Plates 26 and 27). All developments would be subject to the provisions of the forthcoming Environmental Management Act, which will require Environmental Assessments and Management Plans for all new developments listed in the Act. Any such development will also be subject to the Namibia Tourism Board Act 21 of 2000.

Aus

Village Development

At present, Aus is a very small village, with a small bar/restaurant, ungraded hotel, garage and shop. It is sometimes used as a short stop-over for travellers on the road to and from Lüderitz. Unemployment is high. However, there is significant tourism potential in the area due to the presence of stunning scenery and high bio-diversity along the edge of the escarpment, with huge vistas across the desert expanses. The village also borders the south-eastern part of the Namib-Naukluft Park, which has untapped tourist potential e.g. the Koichab area, the mountain massifs such as Dikwillem and the vast red dunes which tower over 300 m above the gravel plains (Plates 28, 29 and 30). The village has the distinction of being one of the very few places in Namibia which receives snow. Snow lying on the red dunes is a rare experience. The Wild Horses of Garub have generated their own mystique, which piques the imagination of many visitors. Aus held an important strategic position during World War 1 and the extensive trenching at Klein Aus – Heinrichsfelde may warrant greater tourism attention. Some entrepreneurs have already started trying to capitalise on the tourist advantages of the Aus region, with a campsite, hiking trail and luxury huts at Klein Aus.

The following are opportunities for development that would lead to the expansion of Aus and an increase in employment opportunities:

- Train stop for the Shongololo Express, including a railway museum about the construction of the Lüderitz railway with possibly a satellite museum at Garub station,
- Hotel(s)/lodges/pubs,
- Winter 'snow experience,'
- Rock art,
- Historical sites e.g. the concentration camp, WW1 trenches and Garub Station,
- Outfitters,
- Upgrade air strip,
- Palaeontological museum,
- Access point for the Namib-Naukluft Park southern section.

Development within the Sperrgebiet near Aus

The north-eastern part of the Sperrgebiet is drier than the south-eastern part near Rosh Pinah, but still can boast grassy plains after good rainfall years, with herds of gemsbok and springbok (Plate 31). The mountain massifs of Tsaukhaib, Letterkuppe, Agub and Tsaus rise up from the desert plains in spectacular fashion, providing plenty of scenic interest (Plates 6 and 32). The Kaukausib valley and fountain (Plate 18) provide historical interest and this part of the Sperrgebiet is the only known location of Barlow's Lark. The north-eastern Sperrgebiet would therefore be suitable for the following activities:

- Guided tours (hiking, horse safaris, camel, 4x4), and
- Guided special interest tours (historical routes, birds, flora, insects, geology and photographic).

These tours would be subject to the same constraints and conditions as described above for the Rosh Pinah area and can take place in Zones 1b and 2. No mechanised transport is allowed in the former.

Development within the Boundary Zone

- It is envisaged that developments similar to those in the Rosh Pinah area would occur near Aus e.g. Klein Aus Vista, capitalising, not only on the Sperrgebiet, but also on the attractions in the Namib-Naukluft Park e.g. sand dunes, Koichab, Dik Willem, Garub Station etc.

Lüderitz

Town Development

Lüderitz is a town of 24 000 people (The Edge Consulting, 2000). Up until 1991 growth was somewhat static due to the demise of diamond mining in the immediate area and the slump in the fishing industry. However, this has changed with the increase in offshore mining, the development of the harbour, permission for tourists to enter Kolmanskop and to visit the historical mines of Pomona and Bogenfels, a new upmarket hotel and conference centre, and the waterfront initiative. The town is set to develop further with an increase in freight through the harbour in response to the Skorpion mine development and the possible future development of a fish farm in Oranjemund. The Kudu Gas project would also see an increase in trade through the town. Although the Sperrgebiet around the town will be inaccessible to tourists, except with pre-obtained permits, the opening up of the rest of the area will act as a magnet for tourists to the area, many of whom will include Lüderitz on their itinerary.

Opportunities for development in and around the town include:

- Waterfront,
- Beaches,
- Angling, crayfishing,
- Harbour cruises,
- Bird and seal tours to Halifax Island, Ichaboe Island and Possession Island,
- Yachting, board sailing,
- Historical museum (ship wrecks, mining history),
- Terminus for Shongololo Express train,
- Mariculture,
- Wind farm development,
- Game viewing at the sewage ponds,
- Walking and horse trails on the Peninsula,
- Environmental awareness centre at Stormvogelbucht,
- Mountain bike route on the Peninsula.

However, in order to accommodate any significant increases in tourist numbers, it will be necessary, **as a matter of urgency**, to upgrade the airport facilities, improve long-term water supplies, town sewerage systems and fuel supplies.

When the current land mining licences are relinquished by Namdeb, it may be possible for the town to expand its tourist base into previously inaccessible parts of the Sperrgebiet.

Within the Sperrgebiet near Lüderitz

At present, the Sperrgebiet around Lüderitz is under exclusive diamond mining licences, and permits have to be applied for in terms of the Diamond Act several months in advance, and require a wealth of original certified documents. This means that spur of the moment tours into the Sperrgebiet to visit the historic mining areas are no longer possible. This will be a major blow for the town of Lüderitz, although the KTC tours to Kolmanskop, Pomona and Bogenfels will still be permissible with correct documentation.

This situation may change when the current land mining licences are relinquished by Namdeb in the future. It is envisaged that the mine tours to Pomona and Bogenfels will then increase in popularity (Plate 33 and 34). Indeed, the old narrow gauge railway to Bogenfels could be re-established to take visitors into the area (Plate 35). The entire coastal zone down to Chameis Bay is interesting from a tourist perspective, with rugged coastal scenery, including the spectacular Bogenfels Arch, seal colonies, the marine reserves, bird tours to Ichaboe and Possession Islands, whale watching and angling. Tours up the coast to Spencer Bay, Saddle Hill and Meob could also increase. Points of interest inland include the Kaukausib valley, Tsaukhaib (also accessible from Aus), the remote Klinghardtberge, and the Ukama 'putte' on the old wagon trail. In the next few years, the Klinghardts will be reserved for scientific study, however, it is envisaged that the public should be allowed access into this wilderness area on a controlled basis in the future.

Sometime in the future, there will also be scope for self-drive 4x4 trails on old mined-out areas, as well as other land uses which could be developed on disturbed land, e.g. a wind park.

At present the Lüderitz waste dump is located in the Sperrgebiet, north east of the town. Litter has been blown across a wide area and there appears to be very little active management of the site. This creates an eye-sore when arriving by air and is unacceptable from an environmental point of view. The waste management situation needs to be addressed by the Lüderitz Town Council as a matter of urgency.

Oranjemund

At present, the town of Oranjemund is a company town, owned and operated by Namdeb. Although a study is currently being conducted into the future proclamation of the town, the provisions of the Diamond Act, with regard to uncontrolled access to, and within a proclaimed town, are unclear. As in the case of access to the Sperrgebiet around Lüderitz, permits will have to be obtained many months in advance, which will not attract many tourists. Even if the town were proclaimed but access restrictions remained in place, it would not alter the situation from a tourist perspective, but other developments may be possible under this scenario e.g. the Bolton Industrial fish farm proposal and the Kudu Gas Power Project. Thus in the next, say 20 years, land use options in Oranjemund are likely to be limited.

There are however, several development opportunities if the town is proclaimed and access controls to the town and immediate vicinity of the river are relaxed.

Town Developments

Most of these opportunities are based on the river and the Ramsar site at the river mouth:

- Hotel(s)/lodge(s) and restaurants,
- Orange River Wetland Park,
- Bird tours,
- Sundowner cruises (weather permitting!),
- End point for canoeing and rafting tours,
- Golf,
- Yachting,
- Special interest tours (flora, fauna in dune hummocks and Pink Pan),
- Fish farm (tours and restaurant),
- Kudu gas plant,
- Shops, banks, Post Office,
- Garage and workshop facilities,
- Camping sites,
- Horse riding,
- 4 x 4 trails,
- Mine museum,
- Upgrading of airport and customs facilities.

Developments within the Sperrgebiet near Oranjemund

Away from the river, the south-western Sperrgebiet around Oranjemund is rather uninteresting (Plate 10), but the following would be possible:

- 4x4 trails on disturbed ground,
- Camel safaris,
- Special interest tours along the river (fauna, flora, insects, palaeontology, history, geology, archaeology),
- Tours to Daberas Gorge,
- Mariculture operations in the old mine ponds.

Land Use Options for the Sperrgebiet

Current Land Use

Before examining possible future land use options for the Sperrgebiet, we must take a look at what is there now, so that we can integrate the land use plan with current land uses.

Mining

At present (2000/1), the only mining that is occurring in the Sperrgebiet is for diamonds (Map 13, page 106). However, the Skorpion Zinc mine received the go-ahead in September 2000 and construction of this mine and plant has started. The following discussion is therefore limited to diamond mining activities.

The six mining licences granted to Namdeb under the 1994 accord are, from north to south, Douglas Bay, Elizabeth Bay, Bogenfels, Mining Area 1, Atlantic 1 and Orange River. Most of Namdeb's production comes from the Mining Area 1 and Atlantic 1 licences (Namdeb, 1997). Each licence area has an approved Environmental Management Plan, which provided the source material for the following descriptions.

Douglas Bay

Mining activities at Douglas Bay involve small-scale mining of beach deposits. This is undertaken by Strauss Mining. A method known as 'dam pumping' is employed whereby gravels are pumped out of the flooded excavations created above the high water mark. Recovery of diamonds takes place on site by wet screening and jigging.

Until 1997, prospecting in the area involved the re-investigation of the German mined-out areas. Samples were processed at a small mobile plant at Charlottenal.

Habitats that have been identified as sensitive within the Douglas Bay Licence Area include the coastal dune hummocks. This thin strip is an essential habitat for a number of animal species including the desert rain frog and the Namaqua dwarf adder, both of which are endemic to this coastal region and are considered endangered. The Douglas Bay Licence Area also contains several historical features including the Charlottenal Diggings and processing plant.

Elizabeth Bay

Mining has occurred intermittently at Elizabeth Bay since the early 1900s, but the current operation was started in 1990. The ore body is situated immediately north of the bay. It is an Aeolian depositional ore body, measuring 5 km long by 3 km wide. The excavated ore is processed at the Elizabeth Bay Process Plant and the concentrate is sent to Oranjemund for final sorting. The fine fraction (-1.4 mm) from the Elizabeth Bay Process Plant is pumped into the bay, while the oversize (+1.4 mm) is deposited on the tailings dump. Recent surveys have shown a decline in the number of breeding pairs of Damara Terns at Elizabeth Bay as a result of an increase in turbidity in the water in the birds' foraging area. The turbidity is thought to be caused by the disposal of fines in the bay. Fresh water and power are sourced from Lüderitz.

Two contractors mine the offshore diamond deposits: Diaz Point Exploration mines the beach and marine deposits up to 100 m offshore; and Windvogel Diamonds mines the nearshore environment up to 30 m depth, using vessel-based units and divers.

Bogenfels

Namdeb has contracted three companies to mine this licence area:

- Sonnberg Diamante mines the isolated pockets and old German tailings near Idatal;
- Diaz Point Exploration mines the beach and marine deposits from 100 m offshore to 100 m above the high water mark, using divers and mobile plant;
- Yam Diamond Recovery operates the deeper marine deposits below 30 m deep.

In recognition of the future tourist potential of the Bogenfels area, Namdeb has set out the following management objectives in the EMPR:

- all sustainable development opportunities need to be identified;
- avoid compromising future opportunities for eco-tourism and fishing;
- all new projects will have to have an EA to investigate the impacts on future land capability;
- identify all archaeological, palaeontological and historical sites;
- apply to the National Monuments Council to declare Pomona and Bogenfels as National Monuments and afford them the highest protection;
- on closure, all buildings, plants and infrastructure which are of no benefit to post-mining land use, will be removed and the sites will be rehabilitated according to a post-mining land use plan (still to be drawn up).

Mining Area 1

The actual mining zone within Mining Area 1 (MA1) is a thin strip of land approximately 100 km long, and varying from 200 meters to three kilometres in width, stretching along the coast north of the Orange River, up to Chameis Bay and includes shallow water concessions up to 5.5 km offshore (Namdeb, 1996).

MA1 is the main land-based operation and includes the following:

- large-scale terrestrial mining operations, subdivided into 6 geographical mining areas that serve 4 metallurgical treatment plants. The diamondiferous gravels are exposed by stripping away the overlying sediments. The ore is crushed, screened and concentrated using sea water and ferrosilicon. The fines are discharged directly on to the beach in the nearshore zone, while the barren

gravels are dumped onto large tailings dumps. The diamonds are recovered from the concentrate using X-ray machines and hand sorting;
- pond dredging in areas where underfoot conditions are too wet for conventional stripping methods. This involves constructing sea walls, which in some areas have resulted in beach accretion of up to 300 m;
- prospecting operations in the licence area;
- the town of Oranjemund;
- shallow water mining by remote methods to depths of up to 80 m by a contractor, Yam Diamond Recovery;
- ancillary operations such as engineering, waste management, water supply from the Orange River ground water aquifers, fuel and power supply, roads, borrow pits etc.

All mining is restricted to an area below the 33 m contour and all rocky outcrops and areas of high biodiversity lie outside the mining area. The older overburden dumps, (more than 40 years old), show an 80% return of species diversity. A considerable amount of research has been spent on designing the most favourable final dump shape to speed up the rehabilitation process (Namdeb, 1997).

The following management objectives have been drawn up for MA1 by Namdeb:

- although diamond mining is currently the most profitable land use option in MA1, and provides the single most important source of income for Namibia, it does exploit a non-renewable resource and therefore longer-term development opportunities need to be identified;
- manage the impacts of mining in order to avoid compromising future development options, in particular, eco-tourism. However, since MA1 comprises only a small part of the Sperrgebiet, its importance for eco-tourism should not be exaggerated, especially when this part of the Sperrgebiet is the least environmentally interesting. Therefore the management objective will be not to rehabilitate the area for eco-tourism *per se*, but to restore it to the extent that it does not detract from eco-tourism in the rest of the Sperrgebiet;
- sites of special scientific interest will be identified and preserved where feasible;
- all infrastructure that cannot be used for some future land use, will be removed or demolished;
- all infrastructure that cannot be removed or demolished will be made safe for humans and animals;
- all waste disposal sites will be rehabilitated according to BATNEEC principles.[16]

Atlantic 1

This licence area is entirely outside of the Sperrgebiet boundaries and will not be addressed here.

Orange River

The Orange River Licence Area occupies the southern part of the Sperrgebiet bordering the Orange River and the eastern boundary fence.

[16] Best Available Technology Not Entailing Excessive Cost

Namdeb's operations in the Orange River Licence Area include:

- Large-scale open-cast mining and processing at Auchas Mine;
- Infield screening operations at Auchas Mine and Sendelingsdrif;
- Prospecting at Sendelingsdrift, Obib, Daberas and Auchas.

The opencast satellite mine at Auchas treated its first ore in June 1990 (Namdeb, 1996). It is situated on the north bank of the Orange River, and exploits ore left in this loop of the river some 17 million years ago (CDM, 1993; Namdeb, 1996). As the Auchas Mine moves into its closing phase (1999/2000), the construction and commissioning of Daberas, also in the Orange River begins (Namdeb, 1999).

The mining operation involves the stripping of the overburden to expose the diamondiferous gravels below. The ore is hauled to a processing plant where it is crushed, screened and concentrated. Of the waste, the fine fraction is discharged into a slimes dam and the coarse fraction is deposited on a tailings dump. Diamonds are recovered from the concentrate using X-ray machines and hand sorting. The water used in the processing is extracted directly from the Orange River.

The Orange River Licence Area is extremely rich in fossils and includes the Arrisdrif fossil pit. The area is also rich in archaeological and historical sites. Many of the Proto terraces found along the north bank of the Orange River have liberal scatterings of Early- and Middle Stone Age tools. It is anticipated that despite best efforts on the part of Namdeb to recover these artefacts, some inevitably will be lost during future mining of these terraces. Grave sites, middens and outcrops with engravings are also located close to these terraces and thus in danger of being damaged by future mining operations.

Security

In view of the nature of the deposit, security in the Sperrgebiet has always been tight. The area was fenced and the fence line was regularly patrolled. Permits to enter the area had to be applied for in advance prior to entry to the area. Although large parts of the Sperrgebiet have been deproclaimed, Namdeb are maintaining the security of the area until a new management system has been drawn up. At that time, Namdeb will only concentrate on securing the fence demarcating the mining licence area boundary and will play no further role in the protection of the rest of the Sperrgebiet. Permits, in terms of the Diamond Act are required to enter any mining licence area, but this provision should be revised for the rest of the area (see page 165).

Prospecting

Current prospecting activities in the Sperrgebiet include ongoing diamond prospecting within the diamond mining licence areas, and base metal exploration on Exclusive Prospecting Licence 2229 (see Map 12, page 100).

A geochemical sampling programme in erosion channels draining the flanks of outcrop areas and inselbergs in EPL 2229 was undertaken by Anglo American Prospecting Services (AAPS) in 1976. Anomalous values of zinc, lead and copper were obtained and follow-up work led to the discovery of gossans in the Skorpion and Eccles Ridge area, indicating significant base metal mineralisation (Reunion Mining, 1997).

A significant amount of drilling and trenching took place and although an ore reserve (with a 3% zinc cut-off) of 8.3 million tonnes at 10.9% zinc and an average stripping ratio of 0.6:1 was identified, no economically viable treatment processes could be found at that time (Corrans et al., 1993).

In 1997, AAPS entered into an agreement with Reunion Mining plc that allowed Reunion to get 60% of the deposit on the submission of a bankable feasibility study. Thus, further drilling, sampling and testing took place in 1997, to provide a check on previous zinc assays and to take a representative sample for metallurgical test work. This new test work proved that the zinc could be recovered economically; indeed it was found that the Skorpion Zinc Mine would be one of the lowest-cost producers in the world. Anglo American then purchased Reunion's share of the project and further test-work was carried out in 1999-2000 to confirm Reunion's prognosis. A bulk sample pit was excavated and a pilot plant was erected off-site to process the material. The project was approved by the Anglo American Board in September 2000.

All prospecting work conducted since Reunion started work at Skorpion in 1997, has been subject to strict environmental control and monitoring, relating to aspects such as:

- drill sites;
- bulk sample pits;
- driller's camp;
- disposal of drilling effluents;
- reservoir sites;
- ablution facilities;
- exploration camp;
- waste disposal;
- litter;
- tracks and off-road driving;
- introduction of alien species; and
- relocation trials of plants from the bulk sample pit site.

Future prospecting activities in the Sperrgebiet are discussed under 'Future Land Use Options'.

Tourism

Kolmanskop Tour Company (KTC) has been operating tours into the Bogenfels mining licence area since 1993 to view the old mines at Pomona and Bogenfels and the Bogenfels Arch (Plates 15, 33 and 34). KTC has renovated one of the old buildings at Pomona as a stopover point for the day tours. KTC also offers shorter tours to visit the old Kolmanskop mine and village, situated next to the main road, just outside Lüderitz.

No other tourism takes place in the Sperrgebiet at present. However, Coast-wise Tour Company offers tours from Lüderitz to Saddle Hill and Spencer Bay in the Namib-Naukluft Park. After heading inland from Lüderitz, the trail turns northwards towards Koichab Pan and through the dunes to join the coastline to the north of the Sperrgebiet boundary, thereby avoiding the mining licence areas. Former mining huts at Saddle Hill are used as a base camp for the three-day tours.

Infrastructure

Map 18, (page 132) shows that there has been some infrastructural development in the Sperrgebiet, mostly to support the towns of Lüderitz and Oranjemund, the mining operations and the security thereof.

Roads and Tracks

The main road inland from Lüderitz to Aus and Keetmanshoop follows the northern boundary of the Sperrgebiet for most of its length. This road is tarred and is maintained by the Department of Roads, and is used by the general public to access Lüderitz.

Two main gravel roads cross the Sperrgebiet to access Oranjemund and the various mining areas: the coastal road from Lüderitz to Oranjemund and the river road from Rosh Pinah to Oranjemund. Both these are wide, gravel roads that were built, and are maintained by Namdeb. There is also a plethora of roads and haul roads in the main mining areas leading from mine sites to the processing plants and various dumps. The construction of these roads required numerous borrow pits to be excavated. While it is acknowledged that a few are required for the upkeep and maintenance of the roads, good environmental practice would suggest that the rest should have been rehabilitated by now.

Elsewhere in the Sperrgebiet, there are a few tracks that were developed by old traders in the 1800s and more modern diamond prospecting and security activities. Most of these tracks have disappeared under mobile dunes and through a lack of use, leaving only a few well-defined, single tracks (Plate 13). It is proposed that these existing tracks should continue to be used in the future wherever possible. However, in some places, unscrupulous visitors have created multiple tracks in the same area, which have left significant scars on the landscape (Plate 36).

Railways

The main line from the port of Lüderitz to the hinterland closely follows the tar road through the northern part of the Sperrgebiet. The railway has recently been used for a tourist train route, and has potential for further developments of this type.

There are also remnants of old railways built by the mines at the beginning of the Diamond Rush. These narrow gauge railways can still be traced through the landscape even though the rails have corroded *in situ* and some embankments have been eroded away (Plate 35). The restoration of these old railways, particularly the ones leading from Lüderitz to Kolmanskop, and from Kolmanskop to Bogenfels, could be an exciting, and more comfortable way of visiting the old diamond mining areas in future.

Airports and Airstrips

Both Lüderitz and Oranjemund commercial airports lie within the Sperrgebiet. These should be upgraded to allow for a greater number of visitors to the area, for both business and tourist purposes.

Power Transmission Lines

A 132 kV power line follows the road/rail corridor through the northern part of the Sperrgebiet to provide Lüderitz with power from the Kokerboom sub-station at Keetmanshoop.

Rosh Pinah mine and village is currently supplied with power via a 66 kV line from South Africa, which crosses the Orange River just east of the Sperrgebiet near Sendelingsdrift. This 66 kV line was extended north-westwards through the Sperrgebiet to provide Lüderitz with power in emergency situations. According to NamPower, this line is now largely redundant, due to other power augmentation schemes in the region. This wooden pole line has a major visual impact on the Sperrgebiet and spoils the wilderness experience (Plate 37). It is strongly recommended therefore, that this line should be removed as soon as possible.

Oranjemund is supplied with power via a 220 kV line from the Oranjemond sub-station in South Africa. This line crosses the river in a very disturbed area and follows the Rosh Pinah road for a few kilometres into Oranjemund. It has a minimal effect on aesthetics.

MA1 is supplied with power via a 66 kV line, which loops through the desert from east of Oranjemund towards the coast. Due to the fact that no tourism occurs in this area at present, this line does not have an impact, but in future when mining ceases, the need for the continued existence of this line should be re-examined.

Radio Masts

Radio masts have been placed at regular intervals up the coast on high ground to facilitate communications between the mines, mining vessels at sea and vehicles travelling along the road. These structures are visually intrusive, especially on Boegoeberg, and should be removed as soon as technology makes their further need redundant, or when land mining finally ceases in the area.

Boreholes and Signage

The eastern sand plains were used in the past for emergency grazing. In order to relieve the pressures of the major drought in 1951, the Government opened up a 16 km strip of land along the eastern boundary fence and 5 boreholes were drilled and equipped with diesel pumps (Plate 18). The area was demarcated with signs every few kilometres, threatening extreme action for trespassing into DA1 (Plate 38). Accounts vary but between 30 000 and 60 000 sheep were grazed here. The area was widened by an additional 8 km in 1955. This emergency measure was repeated in the mid 1960s and again in the early 1980s, but the lack of regular rainfall meant that grazing could not be sustained and it has not been used since. However, the borehole infrastructure remains, with dilapidated buildings and rusty installations. Wires, corrugated iron sheeting, pipes and other debris are scattered around each borehole site, but the old buildings are used for roosting by a number of birds, such as owls, kestrels and crows. There are three possible options for dealing with this:

- investigate the potential for renovating the boreholes, and if they can be re-developed, tidy up the mess surrounding them and repair the buildings;
- demolish and remove all buildings and signage;
- leave as they are, as points of historical interest, but clean up the mess in the surrounding areas.

Guano Buildings and Infrastructure

The buildings on Ichaboe and Possession Islands could be renovated and used for stopover points on day tours to the islands, or overnight facilities (Williams, 1998). The landing facilities could also be used by visitors.

Settlements

Except for the airport, most of Lüderitz, its services, amenities and recreational facilities are excluded from the Sperrgebiet and occur in town lands, or in the Diamond Coast Recreation Area.

Oranjemund, on the other hand, lies in the Sperrgebiet. The triangle of land between the MA1 fence, the sea and the river up as far as Swartkop, is used *inter alia*, for the following purposes:

- township;
- waste disposal;
- water supply infrastructure (well field, reservoir and pipes);
- power distribution;
- sewage disposal;
- golf course;
- yacht club;
- 4x4 trails;
- riding club;
- restaurants;
- camping; and
- angling.

Although these facilities are only for Namdeb employees and their guests, they could be utilised in the future by a wider public, without interfering with the wilderness qualities of the greater part of the Sperrgebiet.

Irrigation Agriculture

In the past, a small irrigation scheme was developed at Daberas to supply the hostel with fresh produce. This scheme has long since been abandoned and indeed this area may be mined in future.

Surrounding Areas

In addition to the integration of the proposed land uses with existing land use in the Sperrgebiet, it is important that whatever is developed inside the fence (which is a somewhat arbitrary line on the map), must compliment the land uses in the surrounding area.

The Namib-Naukluft Park (NNP) lies to the north of the Sperrgebiet. At present, access to the general public is limited pending approval of the NNP Management Plan. Therefore, the only active land use at present is the abstraction of water from the primary aquifer of the Koichab River (see Map , page 46). However, the scenery, presence of game and wild horses will encourage tourists to visit the area in the future (Plates 22, 28, 29 and 30).

The coastal scenery north of Hottentot's Bay up to Meob[17] is also exciting and a tourist concession to this area has already been awarded in the Saddle Hill area and the Koichab (see page 81).

The eastern boundary of the Sperrgebiet is flanked by private farmland for most of its extent, and by the Huns-Ai-Ais Conservation area in the south-east corner (see Map 13, page 104). Land use on these farms includes:

- cattle farming;
- game farming;
- hunting;
- some tourism.

Farming is a marginal activity here due to variable rainfall and grazing and many farms have been abandoned.

The southern boundary is formed by the international boundary between Namibia and South Africa. Land use along the southern bank of the Orange River is dominated by diamond mining, irrigation agriculture on patches of alluvial soil along the river, sheep and goat farming and tourism in the Richtersveld National Park.

[17] Discussed in a separate report entitled 'The Meob-Conception Land Use Plan' (Volume 2).

Future Land Use Options

Prospecting

There is a high degree of prospectivity for diamonds and base metals, but the lack of water could be a constraint. The high degree of environmental sensitivity to disturbance and potential conflicts with tourism would normally make this activity unsuitable for the Sperrgebiet. However, given the low economic base in Namibia, the potential for new mines cannot be ignored. Therefore prospecting is SUITABLE WITH STRICT ENVIRONMENTAL CONDITIONS (see page 101).

Mining

Diamond mining contributes a significant portion (9%) of Namibia's GDP. The Skorpion Zinc project is expected to contribute over 4% to the GDP. By contrast, controlled access tourism to the Sperrgebiet may only contribute a fraction of a percent to the economy of the country (see pages 146-160). However, long-term, sustainable tourism will have a significant impact on the economy of the Karas Region. Thus, mining (which is a resource-depleting activity) is necessary for the short-term benefit of the country and sustainable tourist development is essential for its long-term viability. Some of the proceeds from mining can, indeed, be channelled into longer-term conservation activities to protect the greater part of the Sperrgebiet. Given the shortage of Government funds for aspects such as park management, maintenance and human resources, the income from mining can even be viewed as essential for the development of long-term sustainable tourism and conservation in the area.

Diamond mining will probably continue up to the cessation of the land-based mining licences. The diamond licence areas and Skorpion Zinc have been zoned as category 6 which allows resource use on a controlled basis. Thus mining, although not generally regarded as suitable in such an ecologically-sensitive environment, is essential for the long-term conservation of the Sperrgebiet. Mining is considered to be a SUITABLE LAND USE WITH STRICT ENVIRONMENTAL CONTROL (see page 107). If sensitively done, mining could even augment the tourist experience. In addition to Skorpion, it is estimated that there is a high degree of probability of at least one other mine of a similar size to Skorpion being established in future.

Tourism

Taking into account the sensitivity of the environment and the physical constraints of the area, (e.g. climate, terrain) some proposed tourist activities are more suitable for the Sperrgebiet than others, as shown in the table below.

TOURIST ACTIVITY	SUITABILITY	REMARKS
LAND-BASED ACTIVITIES		
4X4 driving	Suitable only in guided tours in Zone 2	Uncontrolled track development, difficult driving conditions, high risk of breakdowns and getting lost, very low carrying capacity for vehicles

TOURIST ACTIVITY	SUITABILITY	REMARKS
Hiking	Suitable only in guided tours in Zones 1b, 2, 3, 4 and 5)	Harsh climate conditions, high risk of health problems and getting lost, difficult emergency recovery conditions, lack of water, lack of shelter and shade
Camping	Suitable only in guided tours in Zones 1b, 2 and 5	Wilderness camps only. No permanent structures allowed in zones 1-5. It is possible that existing structures could be used at Baker's Bay e.g. once the mining licences lapse along the coast
Horse trails	Suitable only in guided tours in Zones 1b, 2 and 5	Harsh climate conditions, high risk of health problems and getting lost, difficult emergency recovery conditions, lack of water, lack of shelter and shade
Camel Safaris	Suitable only in guided tours in Zones 1b, 2 and 5	Harsh climate conditions, high risk of health problems and getting lost, difficult emergency recovery conditions, lack of water, lack of shelter and shade
Quad bikes	Unsuitable, except on disturbed mining land adjacent to urban areas	Noise pollution, tracks, visual impact. There are other areas outside the Sperrgebiet where this could take place
Rallies (cars, trucks)	Unsuitable	Noise pollution, ecological disturbance, tracks etc. There are other areas outside the Sperrgebiet where this could take place
Train tours	Suitable only on existing railway lines and possibly on restored tracks to the mining areas	A low impact activity using existing infrastructure
Historical tours	Suitable only in guided tours in Zones 1b, 2, 5 and 6	Impacts and development constraints depending on mode of transport
Casinos, health spas, lodges, hotels	Unsuitable except in towns	No permanent structures will be allowed in the Sperrgebiet
AIR-BASED ACTIVITIES		
Fly-in Safaris	Unsuitable	Would require the construction of additional infrastructure in the Sperrgebiet. Noise pollution. Existing air strips are located in the Boundary Zone and development nodes
Plane and helicopter tours	Suitable, only under very strict circumstances	The noise pollution would be unacceptable to visitors to the wilderness, but it may be possible to arrange air tours on one day a week when no land-based tours are in the area
Ballooning	Requires further research	It is uncertain if the climatic conditions are conducive to ballooning. The major concern is the proliferation of tracks during balloon recovery. The impacts of the operation at Namib Rand should be investigated before any decisions are made
WATER-BASED ACTIVITIES		
Canoeing / rafting on the Orange River	Suitable, but may be restricted by the Diamond Act for foreseeable future	The scenery and meanders of the Lower Orange River would make this section of river interesting, but strong winds and fog could make the estuary section difficult and unpleasant. Camps and stopovers on the banks will be governed by the provisions of the Diamond Act for the foreseeable future. Campsites and stop-over points developed in the future would be subject to the same restrictions as wilderness camps

TOURIST ACTIVITY	SUITABILITY	REMARKS
Sundowner cruises and river mouth boat tours	Suitable, but may be restricted by the Diamond Act for foreseeable future	The scale and number of such tours would have to be strictly controlled to avoid disturbance of the birds in the Ramsar Site. Climatic conditions may be adverse for much of the time (wind, fog)
Boat-based eco-tourism	Suitable, but may need permits to travel through mining areas and onto islands	Seal colonies, possibility to view whales and dolphins, large sea-bird colonies, old guano and whaling stations and spectacular coastal scenery. Strong winds and fog will place constraints on these tours. The sensitivity of the bird islands and seal breeding colonies will mean that only guided tours, with limited numbers could visit per time unit e.g. week, month
Angling and cray fishing	Suitable, but limited at present by Lobster Reserves and restricted mining areas	Possible, with strict quotas and monitoring in future, but excluding the proposed marine reserves
Scuba diving	Unsuitable	Extreme cold, very poor visibility, rough seas. Wreck diving would have to be strictly monitored to prevent unlawful removal of artefacts
Sailing, windsurfing, sea kayaking	Suitable in the Lüderitz lagoon	Strong winds make for very exciting sailing in the lagoon

Conservation and Research

In the past, scientific research has been limited by access controls, time and budget constraints. It is clear from the little research that has taken place that there is considerable potential for finding new, previously undescribed species, and species at the furthest limits of their distributional ranges. This LUP therefore has adopted the precautionary principle with regard to conservation and research. Several areas outside of the mining areas (Zone 6) have been Zoned as category 1a (see Map 9, page 60 and Map 16, page 120), which will be reserved in the short-term for scientific research only. Obviously research can take place in all the other zones as well, but there will be other activities taking place in these zones. Once more is known of the 1a Zones in future, they could either be re-categorised as wilderness (Zone 1b) and be subject to non-mechanised access by guided tours, or they could be deemed suitable for proclamation as World Heritage Sites or Biosphere Reserves within the Sperrgebiet National Park.

There is scope for ongoing scientific research in Zone 6 (mining areas), but this would have to be at the discretion of the mining companies concerned.

Given, therefore that the Sperrgebiet falls into one of the world's 25 biodiversity 'hotspots', has a high level of biodiversity of plants, reptiles and insects, has a high degree of endemism, is geologically interesting, has internationally important palaeontological, archaeological and historical sites, is in a largely pristine state and already abuts existing conservation areas, makes it VERY SUITABLE for conservation and research activities. However all activities must adhere to the same strict controls that will be applied to mining, prospecting and tourist uses.

Agriculture

Many forms of agriculture have been proposed, but all have severe limitations, as shown in the table below.

AGRICULTURAL ACTIVITY	SUITABILITY	REMARKS
Irrigation agriculture	Marginal, at only 2 locations on the north bank of the Orange River. Also contingent upon the Diamond Act and mining activities	Depends on crop type (must be high value), management input, irrigation methods, soils, water availability and export markets
Dry land agriculture	Unsuitable	A combination of poor soils, aridity, isolation and extremely harsh climatic conditions, rules out traditional food crop production
Intensive stock farming e.g. pigs, poultry, ostriches	Unsuitable	Lack of water, distance to markets, harsh climate. Other more suitable locations outside the Sperrgebiet
Grazing	Unsuitable	Lack of water; sufficient grazing only occurs for 1-2 years out of 10; ecological sensitivity; would compete with gemsbok, springbok etc. Other more suitable areas found elsewhere in Namibia

Aquaculture and Mariculture

The cultivation of oysters, mussels and seaweed (mariculture) is a thriving business in Lüderitz Bay and Lagoon. Commercial fishing is also centred on Lüderitz, but for various reasons fish stocks have dropped in recent years and quotas have been reduced as a result. Meanwhile, the demand for certain species of fish in Europe is increasing significantly. Artificial farming of fish is therefore considered to be a growth industry (pers. comm. P. Benetto). Fish farming requires easy access to export markets (by plane), water (salt or freshwater) and agricultural production to produce fish food, although the latter can also be imported. Lüderitz, with its existing infrastructure, would seem to be the most suitable location for such a venture, although Oranjemund has some less obvious advantages, such as security, availability of tanks, land availability, buildings suitable for fish processing etc.

Although there is little potential for other mariculture activities in the Sperrgebiet in the short-term, it may be possible to utilise the old mining areas in MA1, once mining ceases in this area. Therefore the Sperrgebiet is only MARGINALLY SUITABLE for aquaculture in the short-term and POSSIBLY SUITABLE for mariculture near Oranjemund in the long-term.

Harvesting

Three suggested land uses fall under this heading: guano harvesting, seal culling and hunting. The guano deposits on the offshore islands have been depleted and only small amounts of guano are removed from Ichaboe Island every year, to supply a very small, niche fertiliser market. This activity is therefore UNSUITABLE.

Seal harvesting is a controversial issue. There is, however, a strong argument from the fishing industry to control seal populations because of their claimed impact on fish stocks and they are thought to be displacing the rare African Penguin in some places. However, seal harvesting would conflict with tourist ideals and therefore should be sensitively handled. If seal harvesting is necessary to maintain the long-term integrity of the Sperrgebiet, then it should be carefully carried out. The proceeds could be used to fund further marine research along the Sperrgebiet coast and to assist in the protection of marine reserves. This land use is SUITABLE, DEPENDING ON THE RESULTS OF ONGOING RESEARCH IN THE AREA.

Commercial hunting would not comply with the principles of a wilderness area or park. There are plenty of alternative places to hunt in Namibia, without resorting to the Sperrgebiet. This land use is UNSUITABLE. However, it may be necessary for park management to occasionally harvest certain species e.g. oryx, to maintain population numbers within the park. It might also be necessary from time to time to round up and sell the desert horses so that their population does not exceed the carrying capacity of the area.

Education and Training

Considerable scope exists to develop educational facilities, but these should be located in the Development Nodes.

Wilderness Training School

Although several wilderness leadership schools and courses exist in Namibia and South Africa, it is thought that the particular conditions that persist in the desert dictate the need for a training facility based in the desert environment, either at Lüderitz, Aus or Rosh Pinah (possibly linked to the Desert Museum (see below). Several training modules could be developed to target different audiences. The development of these modules could be facilitated by the Wilderness Action Group of southern Africa.

Wilderness Awareness Training Module

This would target the following:

- policy makers;
- non-scientific park staff e.g. receptionists, entrance gate guards, etc;
- the Protected Resources Unit (PRU) staff;
- mining company staff, including management;
- prospecting company staff, including management
- contractors; and
- general public.

The course would have to be somewhat flexible, depending on the audience, but should always include the following topics:

- understanding wilderness values, policies and stewardship;
- why the Sperrgebiet is worth preserving;
- the zoning categories of the Sperrgebiet;
- the concept of ‘tread lightly’ and ‘leave no trace’ in the desert environment; and
- the concept of environmental quality and the harmonious integration of different land uses.

This one-day course could be followed by, a day-long excursion into the Sperrgebiet to demonstrate good and bad practice and for the participants to get a 'feel' for the wilderness environment.

Guide Training Module

Any guide wanting to operate in the Sperrgebiet must be approved in terms of the Namibia Tourism Board Act, 21 of 2000. In addition such guides will have to undergo a training course specifically for the Sperrgebiet. This would be a more intense course and would culminate in a test. The course should comprise, *inter alia*:

- wilderness values, policies and stewardship;
- legal aspects;
- wilderness management principles;
- zoning categories and allowable uses;
- emergency search and rescue procedures;
- vehicle mechanics and *in situ* repair;
- navigation by GPS, compass and maps;
- plant and animal identification;
- first aid including CPR;
- 'leave no trace' and 'tread lightly' concepts;
- health and sanitation;
- the Sperrgebiet environment (geology, soils etc);
- biophysical processes;
- history of the Sperrgebiet.

The participants could also be taken on a 2-3 day tour to demonstrate correct and incorrect practices, and to test the principles learnt in the classroom. The aim of the tour would also be to imbue the prospective tour guides with a 'sense of place' and increased appreciation of the special conditions that prevail in the Sperrgebiet.

The prospective guides would need to have either some previous field guide experience with a reputable operator, or the successful completion of a course on nature conservation (or related subject) from an approved tertiary institution.

Park Managers Training Module

This course would be specifically for new staff and those new to a desert environment. It would compliment existing government training courses, but would focus on the specific conditions pertaining to the Sperrgebiet.

In addition to the course outline set out above for tour guides, the park managers training course would include additional aspects such as:

- repair and maintenance in a wilderness area (tracks, trails, fences, etc);
- environmental monitoring;
- control and monitoring of tour guides, prospectors and mining operations;
- poaching and plant theft control and monitoring; and
- public relations, etc.

Desert Museum

There is a desert museum in Tuscon, Arizona which attracts 550 000 visitors per year. It is a world-class museum, featuring the geography, fauna and flora of the Senora Desert. A strong argument exists for the development of a desert museum in Rosh Pinah, which could feature the following:

- what is a desert?
- causes of desertification (natural and anthropogenic);
- geology of the 'oldest desert in the world', including Gondwanaland and plate tectonics;
- gemstones, base metals and their uses;
- exhibits from the Arrisdrift palaeontological site (and others), with reconstructions of some of the more interesting creatures;
- the survival strategies of the San in the desert;
- historical artefacts from the early adventurers and traders to the area (ox wagons, maps showing old routes, archive material etc.);
- the history of mining and how the Sperrgebiet got its name;
- geomorphology, including dune formation and movement, weathering cycles etc.;
- the Orange River – its source, journey and mouth through the eons;
- detritus cycles and seasons of the desert;
- live plant, mammal, bird, insect, arachnid, amphibian and reptile exhibits
- the succulent Karoo Biome;
- survival in arid environments;
- why the desert environment is so sensitive;
- desert rehabilitation programmes; and
- other related topics.

Several facilities could be associated with such a museum, such as:

- a desert plant nursery (to discourage plant theft from the Sperrgebiet and surrounding areas);
- an observatory, to take advantage of the clear night skies;
- a research facility and library, where research scientists can be based during expeditions into the Sperrgebiet. This should include a library, laboratory and facilities for storing and preserving specimens;
- an auditorium to show natural history films and present lectures; and
- a gift and coffee shop.

The museum should be developed from the outset as a world-class facility with state-of-the-art exhibits and multi-media presentations. Funding could be raised by local stakeholders in the area e.g. mining companies, NamPower, the Peace Parks Foundation, the WWF and other NGOs and Aid agencies. The museum would attract visitors in its own right[18] but if it were situated at one of the main gateways to the Sperrgebiet, and incorporated into the Huns-Ai-Ais-Richtersveld Trans-frontier Park, it would create a major attraction. Visitors could spend from a few hours to a whole day in the museum, which would result in additional bed-nights in the area. The museum would also target school children and a visit should become part of the national curriculum, to teach Namibians about an integral part of their inheritance – the desert.

Although the museum would lie outside the Sperrgebiet, it would have strong links with the park and is thus included in this LUP. It would be a HIGHLY SUITABLE land use.

[18] As for the Arizona-Sonora Desert Museum.

Maritime Museum

In addition to the Desert Museum, there is scope to develop a maritime equivalent in Lüderitz, featuring the early explorers, guano harvesters, whalers, sealers, traders and adventurers. Ships and shipwrecks could be a prominent exhibit, together with the natural history of the South-east Atlantic Ocean and the physics of the Benguela current. Mining could be featured here and reconstruction of early mining towns and methods of diamond recovery could be a major attraction (viz. the Big Hole Museum at Kimberley). A maritime museum of this nature would be HIGHLY SUITABLE for the Sperrgebiet and it would compliment and augment the desert museum at Rosh Pinah. Funding would again have to be from the major stakeholders in the area.

Power Generation and Transmission

Although the possible formation of a three-nation Trans-frontier Park encompassing the entire coastal zone of Namibia is a conservation dream, it has to be tempered with practicality. One cannot sever the infrastructure linkages between the economic centre of Namibia (Windhoek) and its only two ports of Walvis Bay and Lüderitz. Similarly, power supply sources and areas of demand are rarely in the same place. This necessitates the building of transmission lines, until such time that technology has advanced to the point that alternative energy (wind, solar) can be used for high demand users.

The various power generation and transmission land uses proposed for the Sperrgebiet are discussed below.

An oil refinery was suggested as a possible land use. This would be UNSUITABLE in the Sperrgebiet. Existing facilities exist at Walvis Bay, and Lüderitz is too far from demand centres.

The presence of vast offshore gas reserves cannot be ignored by a country that imports much of its power. It is also in the interests of strengthening the entire Southern Africa Power Pool that this relatively 'clean' source of power should be utilised. The Kudu Gas Field lies directly off the Sperrgebiet coast and therefore there is no option but to bring the gas onshore somewhere on this coast. Oranjemund was selected as the preferred location for the Kudu Gas Power Plant, but from an environmental point of view, Lüderitz would be the most suitable location. Based on technical or financial grounds, this location was dismissed early in one of the feasibility studies, but in light of the development of the Sperrgebiet as a National Park, this decision should be re-examined. The site in Oranjemund was chosen on the basis of *inter alia*, it having the least environmental impact i.e. on mined out, disturbed ground. The real impact, however, is caused by the 400 kV transmission line which will have to cross the Sperrgebiet to connect into the national grid at Keetmanshoop.

This transmission line was the subject of an exhaustive Route Selection Study and Environmental Assessment and although the route with the lowest impact was selected, this type of development is incompatible with the guiding principles for wilderness areas.

A more environmentally suitable scenario, given the proposals for the Sperrgebiet in this LUP, would be to bring the gas on-shore near Lüderitz (or even Walvis Bay) and construct the gas power plant there. Even though a new power line would have to be constructed[19], it could follow the existing infrastructure corridor which already contains the road, railway and 132 kV line. However, the Skorpion Zinc Mine will require power in the near future. The current proposal is to construct a 400 kV line from the Kokerboom substation at Keetmanshoop directly to Skorpion through technically-challenging terrain. This would be extended to the Kudu Power Plant at Oranjemund whenever that would be developed. Working on the same principles that are being applied to the Oranjemund location, a 400 kV line could be built from Kokerboom parallel to the existing 132 kV line to Lüderitz[20] with a T-off to Skorpion in the vicinity of Aus. When the Kudu gas plant is eventually developed, the 400 kV line would be extended from Aus to Lüderitz.

It is acknowledged that planning for the Oranjemund scenario is far advanced, but the integrity of the Sperrgebiet for future generations should not be compromised by short-sighted planning. The impact of the Lüderitz scenario on the Sperrgebiet National Park would be minimal in comparison.

A wind park has been proposed in the Sperrgebiet near Lüderitz and is currently the subject of an Environmental Assessment. The Environmental Assessment will consider, *inter alia*, the visual impact of the site, especially for visitors to the Diamond Coast Recreation Area and from the proposed Kolmanskop railway tours. The compatibility and desirability of such an installation in a proposed protected area will also be considered in the Environmental Assessment. The suitability of this land use will depend on the findings of the Environmental Assessment.

Large scale solar power installations will be an UNSUITABLE land use for the Sperrgebiet, but small-scale use could be considered, e.g. if the boreholes were to be re-activated it would be preferable if they were driven by solar power rather than diesel. No other installations requiring solar power are envisaged in the Sperrgebiet.

Miscellaneous

A variety of miscellaneous land uses were suggested during the public participation programme (see Appendix C.4). The suitability of these in the Sperrgebiet is summarised in the following table.

ACTIVITY	SUITABILITY	REMARKS
'Silicon-valley' type industrial development at Oranjemund	Unsuitable	More suitable and accessible locations exist elsewhere in Namibia
Salt mining	Unsuitable	More suitable and accessible locations exist elsewhere in Namibia
Toxic waste disposal	Unsuitable	The import of toxic waste contravenes the Namibian Constitution. Locally-generated toxic waste can be disposed of in more suitable and accessible places in Namibia

[19] The existing 132 kV would not be capable of transmitting 400 kV.

[20] The Skorpion Zinc Mine requires at least 220 kV and can not take power from the existing 132 kV.

ACTIVITY	SUITABILITY	REMARKS
Commercial film production	Unsuitable	Too damaging to the environment due to vehicles, people. Other suitable locations exist in Namibia

The land uses that are deemed to be suitable (with or without conditions) in the Sperrgebiet National Park, are discussed in more detail in the following sections (1-8).

Each potential land use is discussed in terms of:

- areas of opportunity;
- a list of major activities associated with the land use;
- key requirements and inputs required for the specified land use to be successful;
- key residues and emissions;
- issues for inclusion in an EA;
- key elements of an EMP; and
- key constraints.

Guidelines for Future Land Use Options

This LUP strongly recommends that current and future decision-makers recognise the Sperrgebiet as a global and national asset and that all land use decisions should aim to achieve the ultimate objective of sustainable development. Activities that are economically marginal in the context of the national interest, must not be allowed.

1. Prospecting 

2. Mining 

3. Tourism 

4. Conservation and Research 

5. Irrigation Agriculture 

6. Mariculture and Aquaculture 

7. Power Generation and Transmission 

8. Education and Training 

Map 12: Current Prospecting Interest (2000)

(Amended; sources cited)

1. Prospecting

Sub-Sectors

- ☐ **Diamonds**
- ☐ **Precious, Base and Rare Metals**
- ☐ **High Value Industrial Minerals**

Current Areas of Opportunity

DIAMONDS:

WHERE:	WHO:	WHEN:	HOW:	WHY:
2615 AD and 2615 CB NE of Lüderitz	Diamond Fields Namibia	2000→	*	Transported diamonds could occur in the sand dunes

PRECIOUS, BASE AND RARE METALS:

WHERE:	WHO:	WHEN:	HOW:	WHY:
2715 BA, NW of Klinghardtberge	PE Minerals	2000→	*	Both the Rosh Pinah and Skorpion Zinc ore bodies are found in the rocks of the Rosh Pinah formation of the Gariep Complex. These rocks trend in a gentle NW direction, from Rosh Pinah, past Aurusberg and Klinghardt Mountains to Pomona. It is thought, therefore that this area is highly prospective.
2716 AA, Around Tsaus	Cominco	2000→	*	
2716 AC, Anib Pan, NE of Aurusberg	Cominco	2000→	*	
2715 BC, West of Klinghardtberge	PE Minerals	2000→	*	
2715 BD, Klinghardtberge	PE Minerals	2000→	*	
2716 CA, Aurusberg/Roter Kamm	Rio Algom	2000→	*	
2716 CB-1, NE of Aurusberg, Nr Borehole 4	PE Minerals	2000→	*	
2716 CB-2, North of Rooiberg	Westport Resources	2000→	*	
2716 CB-3, South of Aurusberg	Skorpion	2000→	*	
2716 CB-4, Around Rooiberg	Skorpion	2000→	*	
2716 DA-3, North of Skorpion, Nr Borehole 5	Skorpion	2000→	*	
2716 CC, East of Boegoeberg	PE Minerals	2000→	*	
2716 CD-1, Central Sperrgebiet	Avmin	2000→	*	
2716 CD-2, West of Skorpion	Skorpion	2000→	*	
2716 DC-1, immediately adjacent on west of Skorpion (EPL 2229)	Skorpion	2000→	*	
2716 CD-3, CD-4, 2716 DC-3, 2816 BA-1, BA-2, BA-4, South Central Sperrgebiet, North of Obib and Schakalberg	PE Minerals	2000→	*	

* pending approval of EMPs by MME and MET
Source: MME, 2000

(See Map 12, page 100)

Major Activities

- ☐ **Geophysics**
  - Aerial
  - Ground
- ☐ **Air photo interpretation**
- ☐ **Remote sensing and mapping**
- ☐ **Trenching**
- ☐ **Surface sampling**
- ☐ **Drilling**
  - Percussion
  - Diamond
- ☐ **Bulk sampling**
- ☐ **Decommissioning**

Key Requirements and Inputs

- ☐ **Geological prospectivity**
- ☐ **Access roads and tracks**
- ☐ **Water abstraction and supply (boreholes / water tanker / pipeline)**
  - Potable water
  - Drilling water (for diamond drilling)
- ☐ **Water storage (reservoir / tank)**
- ☐ **Ablution amenities**
  - Sanitation (pit system / french drain)
  - Taps, showers
- ☐ **Accommodation and offices (prefabs / caravans / tents)**
- ☐ **Storage sheds** (prefabs)
- ☐ **Vehicles and equipment**
  - 4x4 vehicles
  - Drill rigs
  - Water tanker (if applicable)
  - Earthmoving equipment (for bulk sampling)
  - Compressors
  - Pumps
- ☐ **Waste disposal**
  - Domestic
  - Industrial / hazardous
- ☐ **Power supply (generator / power line / gas)**
  - Drilling
  - Lighting
  - Cooking
  - Space heating
- ☐ **Fuel supply, storage and transfer** (refuelling station)
- ☐ **Hazardous substances**
  - Lubrication chemicals (for drilling)
  - Other
- ☐ **Labour**
- ☐ **Supporting services** (Rosh Pinah)
  - Health care
  - Banking
  - Fuel supply
  - Post and telecommunications
  - Waste disposal
  - Accommodation
  - Recreation facilities
  - Workshops / garages
  - Air strip
  - Shops

Key Residues and Emissions

- ☐ **Prospecting waste**
  - Drilling mud
  - Drilling sumps
  - Excavated material (from trenches, pits)
- ☐ **Prospecting residues**
  - Rock chips
  - Drill core
- ☐ **Construction and demolition rubble**
  - Concrete slabs (bunds / flooring)
- ☐ **General waste**
  - Food scraps, paper, board, wood, plastic, glass, other
- ☐ **Sewage and waste water**
- ☐ **Industrial / hazardous waste**
  - Used chemicals, lubricants, oil and vehicle fluids, scrap metal, other
- ☐ **Dust**
- ☐ **Noise and vibrations**
- ☐ **Visual pollution**
  - Litter and waste
  - Lighting
  - Roads and tracks
  - Campsite
  - Prospecting works (trenches, pits, etc.)

Issues for inclusion in an EA

- ☐ Baseline environmental conditions and levels of existing damage and pollution
- ☐ Project description
- ☐ Potential environmental impacts and issues
- ☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Loss of protective ground cover** (highly significant in arid environments with very slow recovery rates) ➜ Loss of habitats ➜ Impacts on biodiversity ➜ Loss of endemic and protected species	– Disturbances to the fragile desert pavement and vegetation, vegetation removal – Incorrect siting of campsites and tracks – Unconfined activities around campsite and prospecting works – Proliferation of tracks – Excessive vehicle movement – Sourcing of construction materials (borrow pits)
☐ **Impacts on soil (chemical composition, erosion, compaction)** ➜ Loss of soil nutrients ➜ Loss of potential to support vegetation growth ➜ Areas permanently denuded of vegetation	– Loss of protective ground cover – Movement of heavy vehicles – Exposure of soil and stockpiles to wind erosion – Loss of topsoil and natural seedbank – Contamination from ablution facilities and hazardous substances
☐ **Dust** ➜ Formation of dunelets ➜ Movement of large quantities of sand ➜ Limits plant growth	– Earthworks and excavations – Loss of protective ground cover (this can cause problems even over small areas and is not to be underestimated) – Disturbances to top layer of soil
☐ **Noise and vibrations** ➜ Land use conflict – intrusion on nearby tourist activities and accommodation establishments (not problematic at present but would impact on future tourism developments) ➜ Disturbances to fauna (chasing away animals)	– Drilling and earth moving equipment – Vehicle movement – Generators, compressors – Human activity
☐ **Impacts on fauna** ➜ Loss of biodiversity ➜ Loss of endemic and protected species	– Loss of habitats – Noise and vibrations – Soil handling, affecting ground living organisms (i.e. *psammophilous* spp.)
☐ **Alien / invasive species**	– Introduction of alien / invasive fauna (e.g. mice) and plants (e.g. prickly pear) to campsites
☐ **Impacts on ground water (resource depletion, quality)** ➜ Impacts on micro-habitats and biodiversity ➜ Ground water is a scarce resource. Very little recharge occurs in most parts of the Sperrgebiet. ➜ Any use of the resource means that the resource will be mined. Water quality is generally poor. Hydraulic links to coast exist in places where water occurs in seeps and fountains, these support important micro-habitats	– Contaminants entering stream channels and underground aquifers – Indiscriminate water abstraction – Wastage of a scarce resource

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Visual impacts** (highly significant in a wilderness area with low visual absorption capacity and slow rate of recovery) ➔ Land use conflict – intrusion on nearby tourist activities and accommodation establishments (not problematic at present but would impact on future tourism developments)	– Litter and waste – Incorrect siting of campsites and tracks – Proliferation of tracks – Lighting – Signs of human activity in a wilderness area
☐ **Impact on heritage sites and artefacts (palaeontological, archaeological, historical, cultural)**	– Incorrect siting of campsites and alignment of tracks – Unconfined activities around campsite and prospecting works – Proliferation of tracks
☐ **Social structures** ☐ **Health and safety** ☐ **Risks and hazards**	– Employment conflict, influx of jobseekers – Spreading of HIV / AIDS – Road safety – Working conditions – Public safety
☐ **Cumulative impacts**	– Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - – Contractual commitment
  - – Financial provision
  - – Roles and responsibilities
  - – Penalties / incentives
  - – Monitoring
- ☐ **Environmental awareness**
  - – Environmental code of conduct
  - – Training programme
- ☐ **Employment / social structures**
  - – Recruitment
  - – Employment conflict
  - – Demographics
  - – Influx of jobseekers
- ☐ **Public relations / land use conflict**
  - – Noise
  - – Vibrations
  - – Aesthetics
  - – Information dissemination
  - – Complaints and grievances
  - – Trespassing
  - – Illegal access into restricted areas
- ☐ **Site establishment**
  - – Siting and utilisation of campsites, prospecting works, etc.
- ☐ **Roads and tracks**
  - – Alignment
  - – Dust, erosion
  - – Haphazard and off-road driving
  - – Maintenance
  - – Road safety
- ☐ **Pollution control and handling of hazardous substances**
  - – Pollution
  - – Health
- ☐ **Litter and waste management**
  - – Minimisation, recycling
  - – Collection
  - – Treatment
  - – Storage
  - – Transportation
  - – Disposal
- ☐ **Protecting the biophysical environment**
  - – Air quality, dust
  - – Water resources, water consumption
  - – Protective ground cover, topsoil
  - – Erosion
  - – Habitats and biodiversity
  - – Endemic and protected species
  - – Rescue operations
  - – Poaching and collection of animals and plant material
  - – Invasive species

- ☐ **Landscape quality**
  - Visual intrusion and degradation
  - Tourism potential
- ☐ **Protecting heritage sites and artefacts**
  - Cultural
  - Historical
  - Archaeological
  - Palaeontological
- ☐ **Health and safety**
  - Harsh climatic conditions
  - HIV / AIDS
  - Occupational risks and hazards
  - Public risks and hazards
- ☐ **Decommissioning**
  - Restoration and rehabilitation

Key Constraints

- ☐ Sensitivity of the Sperrgebiet environment, importance of the area for conservation and research
- ☐ Land use conflicts, especially with potential tourism developments
- ☐ Remoteness of the area
- ☐ Harsh climatic conditions
- ☐ Scarcity of water resources and poor water quality
- ☐ Lack of supporting infrastructure and services
- ☐ Current Sperrgebiet security regulations and access control

Map 13: Mining

(Amended; sources cited)

2. Mining

Sub-Sectors

- ☐ **Diamonds**
- ☐ **Precious, Base and Rare Metals**
- ☐ **High Value Industrial Minerals**

Current Areas of Opportunity

DIAMONDS:

WHERE:	WHO:	WHEN:	HOW:
1. Old dumps in MA1	Namdeb	2000→09	Retreatment
2. Old dumps in MA1	Namdeb	2000→12/13	Retreatment
3. Pocket Beaches (Chameis to Bogenfels)	Namdeb	2000→09	Dredging
4. Elizabeth Bay	Namdeb	→2006(11?)	Conventional
5. MA1	Namdeb	Ongoing	Conventional
6. Surf Zone along whole coast	Namdeb	→2020	Dredging
7. Islands	Concessionaires	→2020	Dredging
8. Auchas Alluvial	Namdeb	→2000	Open Pit
9. Daberas Alluvial	Namdeb	2000→10	Open Pit
10. Obib	Namdeb	2001→05	Open Pit
11. Sendelingsdrif	Namdeb	2005→14	Open Pit

Source: Namdeb

PRECIOUS, BASE AND RARE METALS:

WHERE:	WHO:	WHEN:	HOW:	WHY:
20 km NW of Rosh Pinah	Skorpion Zinc	2000→16	Open Pit	Proven ore reserve

Source: Skorpion Zinc

(See Map 13, page 106)

Major Activities

- ☐ **Construction**
  - Access roads
  - Mining plant and infrastructure
  - Supporting services (power lines, water pipelines, etc.)
  - Waste disposal facilities
  - Storage facilities
  - Mining village, offices and associated amenities
- ☐ **Operation**
  - Drilling and blasting
  - Earthworks / trenching / excavations
  - Ore transportation / conveyance
  - Stockpiling and crushing
  - Mineral processing, extraction, recovery
  - Mining waste disposal (overburden, waste rock, tailings)
  - Transportation and storage of hazardous substances
- ☐ **Rehabilitation and revegetation**
- ☐ **Decommissioning**

Key Requirements and Inputs

- ☐ **Proven ore reserve in the national interest**
- ☐ **Market demand**
- ☐ **Access roads**
- ☐ **Construction materials**
- ☐ **Mining plant and infrastructure**
  - Ore crushing, processing, extraction, recovery
  - Conveyors, stockpiles
  - Offices, workshops, etc.
- ☐ **Water abstraction and supply** (boreholes / pipeline)
  - Construction water
  - Mining and mineral processing water
  - Potable water
- ☐ **Water storage and reticulation (reservoirs / ponds / pipeline)**
- ☐ **Vehicles and mining equipment**
- ☐ **Waste disposal**
  - Domestic
  - Mining
  - Industrial / hazardous
- ☐ **Power supply** (power line)
  - Mining
  - Housing and related facilities
- ☐ **Fuel supply**
- ☐ **Fuel storage and transfer**
- ☐ **Hazardous substances**
- ☐ **Explosives**
- ☐ **Labour**
- ☐ **Supporting services**
  - Health care
  - Banking
  - Fuel supply
  - Post and telecommunications
  - Accommodation
  - Recreation facilities
  - Workshops / garages
  - Air strip
  - Shops
  - Security

Key Residues and Emissions

- ☐ **Pits and trenches**
- ☐ **Mining waste**
  - Overburden
  - Waste rock
  - Tailings
- ☐ **Sewage**
- ☐ **Waste water**
  - Domestic
  - Mining and processing
- ☐ **General waste**
  - Food scraps, paper, board, wood, plastic, glass, etc.
- ☐ **Industrial / hazardous waste**
  - Used chemicals, lubricants, oil and vehicle fluids, scrap metal, etc.
- ☐ **Construction and demolition rubble**
- ☐ **Gaseous emissions from mineral processing (smelters)**
- ☐ **Dust**
- ☐ **Noise**

☐ **Vibrations and flyrock**
☐ **Visual pollution**
- Litter and waste
- Lighting
- Roads and tracks
- Air-borne emissions
- Mining infrastructure and equipment
- Waste rock dumps
- Tailings impoundments
- Overburden dumps
- Ore stockpiles
- Visible emissions
- Housing, offices and related facilities

Issues for inclusion in an EA

☐ Baseline environmental conditions and levels of existing damage and pollution
☐ Project description
☐ Potential environmental impacts and issues
☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Loss of protective ground cover** (highly significant in arid environments with very slow recovery rates) ➜ Loss of habitats ➜ Impacts on biodiversity ➜ Loss of endemic and protected species	– Disturbances to the fragile desert pavement and vegetation, vegetation removal – Incorrect siting of roads, mining infrastructure, mineral processing plant, waste dumps, tailings impoundments, stockpiles – Unconfined activities around mining operations – Proliferation of tracks – Excessive vehicle movement – Sourcing of construction materials (borrow pits)
☐ **Impacts on soil (chemical composition, structure, erosion, compaction, stability)** ➜ Loss of soil nutrients ➜ Loss of potential to support vegetation growth ➜ Areas permanently denuded of vegetation	– Loss of protective ground cover – Movement of heavy vehicles – Exposure of soil and stockpiles to wind erosion – Loss of topsoil and natural seedbank – Contamination from sewage and hazardous substances, mineral processing, extraction and recovery
☐ **Impacts on air quality** ➜ Dust ➜ Gaseous emissions	– Gaseous emissions from on-site processing (smelting) – Earthworks and excavations – Vehicle movement – Loss of protective ground cover (problematic even over small areas, not to be underestimated) – Ore crushing, conveyance and transportation – Erosion of stockpiles, overburden and waste rock dumps and tailings impoundments – Disturbances to topsoil – Replacement of subsoil and topsoil
☐ **Noise, vibrations and flyrock** ➜ Land use conflict – intrusion on nearby tourist activities and accommodation establishments (not problematic at present but would impact on future tourism developments) ➜ Disturbances to fauna (chasing away animals)	– Drilling and blasting – Earth moving equipment – Vehicle movement – Crushers, generators, compressors – Mineral processing – Human activity
☐ **Impacts on fauna** ➜ Loss of biodiversity ➜ Loss of endemic and protected species	– Loss of habitats – Noise, vibrations an flyrock – Off-road driving – Soil handling, affecting ground living organisms (i.e. *psammophilous* spp.)
☐ **Alien / invasive species** (risks of spreading limited by harsh climatic conditions)	– Introduction of alien / invasive fauna (e.g. mice) and plants (e.g. prickly pear) to campsites

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Impacts on ground water (resource depletion, quality)** ➔ Impacts on micro-habitats and biodiversity ➔ Ground water is a scarce resource. Very little recharge occurs in most parts of the Sperrgebiet. Any use of the resource means that the resource will be mined ➔ Water quality is generally poor. Hydraulic links to coast exist in places where water occurs in seeps and fountains, these support important micro-habitats	– Waste water (mineral processing, extraction and recovery, sewage treatment) and contaminants entering stream channels and underground aquifers – Indiscriminate water abstraction – Wastage of a scarce resource – Stockpiles, waste dumps and tailings impoundments – Leaching of heavy metals – Disruption of ground water aquifers
☐ **Impacts on surface water (resource depletion, quality)** (impacts on surface water largely depend on the location, water consumption and processes used and at the mining operation) ➔ Impacts on riparian habitats and biodiversity	– Waste water (mineral processing, extraction and recovery, sewage treatment) – Contaminants entering stream channels (acid mine drainage, heavy metals) – Indiscriminate water abstraction – Wastage of a scarce resource – Sedimentation – Alteration of water courses
☐ **Visual impacts** (highly significant in a wilderness area with low visual absorption capacity and slow rate of recovery) ➔ Land use conflict – intrusion on nearby tourist activities and accommodation establishments (not problematic at present but would impact on future tourism developments)	– Litter and waste – Air-borne emissions – Incorrect siting of roads, mining infrastructure, mineral processing plant, waste dumps, tailings impoundments, stockpiles – Proliferation of tracks – Lighting – Signs of human activity in a wilderness area
☐ **Impact on heritage sites and artefacts (palaeontological, archaeological, historical, cultural)**	– Incorrect siting of roads, mining infrastructure, mineral processing plant, waste dumps, tailings impoundments, stockpiles – Unconfined activities around mining activities – Proliferation of tracks
☐ **Social Structures** ☐ **Health and Safety** ☐ **Risks and Hazards**	– Employment conflict, influx of jobseekers – Spreading of HIV / AIDS – Road safety – Working conditions – Public safety
☐ **Cumulative Impacts**	– Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment
☐ **Economic analysis**	– Contribution to GDP and national interest – Cost-benefit analysis

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - – Contractual commitment
  - – Financial provision
  - – Roles and responsibilities
  - – Penalties / incentives
  - – Monitoring
- ☐ **Environmental awareness**
  - – Environmental code of conduct
  - – Training programme
- ☐ **Employment / social structures**
  - – Recruitment
  - – Employment conflict
  - – Demographics
  - – Influx of jobseekers

- ☐ **Public relations / land use conflict**
  - Noise
  - Vibrations
  - Aesthetics
  - Information dissemination
  - Complaints and grievances
  - Trespassing
  - Illegal access into restricted areas
- ☐ **Site establishment**
  - Siting and utilisation of campsites, prospecting works, etc.
- ☐ **Roads and tracks**
  - Alignment
  - Dust, erosion
  - Haphazard and off-road driving
  - Maintenance
  - Road safety
- ☐ **Pollution control and handling of hazardous**
  - substances
  - Pollution
  - Health
- ☐ **Litter and waste management**
  - Minimisation, recycling
  - Collection
  - Treatment
  - Storage
  - Transportation
  - Disposal
- ☐ **Protecting the biophysical environment**
  - Air quality
  - Ground and surface water resources
  - Water consumption
  - Protective ground cover, topsoil
  - Erosion
  - Habitats and biodiversity
  - Endemic and protected species
  - Rescue operations
  - Poaching and collection of animals and plant material
  - Invasive species
- ☐ **Landscape quality**
  - Visual intrusion and degradation
  - Tourism potential
- ☐ **Protecting heritage sites and artefacts**
  - Cultural
  - Historical
  - Archaeological
  - Palaeontological
- ☐ **Health and safety**
  - Harsh climatic conditions
  - HIV / AIDS
  - Occupational risks and hazards
  - Public risks and hazards
- ☐ **Decommissioning**
  - Restoration and rehabilitation

Key Constraints

- ☐ Sensitivity of the Sperrgebiet environment, importance of the area for conservation and research
- ☐ Land use conflicts, especially with potential tourism developments
- ☐ Remoteness of the area
- ☐ Harsh climatic conditions
- ☐ Scarcity of water resources and poor water quality
- ☐ Lack of supporting infrastructure and services
- ☐ Current Sperrgebiet security regulations and access control

Map 14: Tourism 2000

(Amended)

3. Tourism

Sub-Sectors

☐ **Guided Special Interest Tours**
- ➔ Scientists / tour operators / concessionaires / academic and research institutions
- □ Photography (scenery, fauna and flora)
- □ Scientific (archaeology, palaeontology, history, botany, birds, invertebrates, reptiles, geology, etc.)

☐ **Guided General Interest Tours**
- ➔ Tour operators / concessionaires
- □ Culture and history
- □ Nature and wildlife
- □ Wilderness orientated

Tourism Development Nodes

☐ **Rosh Pinah**
☐ **Aus**
☐ **Lüderitz**
☐ **Oranjemund**

Links with Surrounding Tourism Areas

☐ **Boundary Zone**
Private farms along the eastern boundary of the Sperrgebiet

☐ **Neighbouring conservation areas**
Huns Ai-Ais, Richtersveld and southern Namib-Naukluft Park

☐ **Upper Orange River**
Orange River upstream of Sendelingsdrift

☐ **Coastal Islands**
Halifax Island near Lüderitz
Outer islands (Possession, Ichaboe and Mercury Islands)

☐ **Lüderitz Recreation Area**
Coastal strip from Lüderitz to Grossebucht.

Links with Recreation Activities

☐ **Coastal Strip**
- – Beach / harbour activities
- – Boat rides
- – Yachting
- – Scuba diving
- – Crayfish and shellfish collection
- – Angling

☐ **Orange River**
- – Sundowner cruises / boat rides

☐ **Towns (development nodes)**
- – Golf
- – Restaurants, pubs, etc.

Map 15: Tourism 2020

(Amended)

Areas of Opportunity

- ☐ **Tourism from 2000 to 2020 – with restricted Mining Areas**
- ☐ **Tourism from 2020 onwards – once land-based diamond mining winds down.**

WHAT	WHERE	WHEN
Hotels, guest houses, bed and breakfast establishments	Lüderitz, Aus, Rosh Pinah	2000→
	Oranjemund	2020→
Lodges	Boundary Zone, Neighbouring Parks	2000→
Wilderness camps	Sperrgebiet Zone 1b and 5,	2000→
	Boundary Zone, Neighbouring Parks	2000→
Camping sites	Lüderitz, Aus, Rosh Pinah	2000/2→
	Boundary Zone, Neighbouring Parks	2000→
Tourist stopovers / rest areas / picnic sites (day visitors)	Sperrgebiet Zone 5	2000→
	Boundary Zone, Neighbouring Parks	2000→
	Lüderitz, Aus, Rosh Pinah	2000→
	Oranjemund	2020→
Guided special interest tours – Photography (scenery, fauna and flora), – Scientific (archaeology, palaeontology, history, botany, birds, invertebrates, geology, etc.) – Mining areas e.g. Skorpion Zinc	Sperrgebiet Zone 1b Sperrgebiet Zone 6 Sperrgebiet Zone 5 Halifax Island Orange River mouth and wetlands Outer coastal islands (Possession, Ichaboe and Mercury Islands) Marine Reserves	2000→
Guided general interest tours – Culture and History – Nature and Wildlife – Wilderness Orientated	Sperrgebiet Zone 5	2000→
	Halifax Island	2000→
	Lüderitz, Aus, Rosh Pinah	2000→
	Oranjemund	2000→
	Boundary Zone, Neighbouring Parks	2000→
	Sperrgebiet Zone 6 (coastal strip and lower Orange River)	2020→

(See Map 14: Tourism 2000, page 112 and Map 15: Tourism 2020, page 114)

Key Requirements and Inputs

- ☐ **Tourism appeal / marketable tourism package**
- ☐ **Economic viability**
- ☐ **Amenable climate**
- ☐ **'Critical mass' and variety of tourism and recreation attractions**
- ☐ **Trained staff** (i.e. registration and certification as tour operator / guide)
- ☐ **Concessions / permits** (for Sperrgebiet and neighbouring parks)
- ☐ **Contracts / agreement with landowners** (for operations on private land)
- ☐ **Publicity / advertising campaign**
- ☐ **Booking office / administration**
- ☐ **Staff quarters**
- ☐ **Accessibility**
  - Roads and tracks
  - Airport / airstrip
  - Railway line
  - Pont
  - Security control points and entrance gates (Sperrgebiet / Richtersveld, Huns Ai-Ais and Namib-Naukluft Park)
  - Border post / customs post

- ☐ **Transportation and equipment**
  - 4x4 passenger vehicles
  - Camels / horses
  - Support vehicles
  - Ferries / boats / canoes / rafts / kayaks
  - Catering and camping equipment
  - Maps, GPS, radio, etc.
- ☐ **Emergency equipment / evacuation procedures**
  - Backup vehicles
  - Emergency support staff
  - Recovery equipment, spares
  - First aid
  - Emergency lodgings (i.e. shelter for use under unexpected conditions and breakdowns)
  - Communication system (radio / satellite phone)
- ☐ **Accommodation**
  - Hotels, lodges
  - Guest houses, bed and breakfast establishments
  - Camping sites
  - Wilderness camps
- ☐ **Tourist stopovers / rest areas / picnic spots**
- ☐ **Water storage and transportation** (tanks / portable containers)
- ☐ **Waste management**
  - Collection and temporary storage
  - Disposal
- ☐ **Ablution amenities (sanitation, showers, etc.)**
  - Portable (chemical toilets)
  - Fixed systems (pit / french drain)
- ☐ **Power supply (solar / generator / gas)**
  - Lighting, cooking, space heating
- ☐ **Fuel storage, transportation and transfer**
- ☐ **Supporting services (Rosh Pinah, Aus, Lüderitz, Oranjemund)**
  - Water supply
  - Fuel supply
  - Garages / workshops
  - Banks
  - Post and telecommunications
  - Outfitters / equipment suppliers (camping, hiking, horse riding, etc.)
  - Emergency services / health care
  - Shops (i.e. fresh produce, curios / souvenirs, etc.)
  - Recreational activities (restaurants, pubs, etc.)
- ☐ **Information centres (desert museum, maritime museum, wilderness leadership school)**

Key Residues and Emissions

- ☐ **Visual pollution**
  - Litter
  - Lighting
  - Roads and tracks
  - Campsites
  - Rest areas / picnic spots
- ☐ **Sewage and waste water**
- ☐ **General waste**
- ☐ **Noise / disturbances to wildlife**

Issues for inclusion in an EA

- ☐ Baseline environmental conditions and levels of existing damage and pollution
- ☐ Project description
- ☐ Potential environmental impacts and issues
- ☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Proliferation of roads and tracks** (highly significant in arid environments with very slow recovery rates – one of the most dramatic impacts of tourism access into the Sperrgebiet) ➜ Disturbances to the fragile desert pavement and vegetation, loss of protective ground cover ➜ Wind erosion, dust, formation of dunelets and movement of large quantities of sand	– Haphazard driving – Unconfined activities and access into sensitive areas – Incorrect alignment of tracks – Siting of wilderness camps, picnic spots and rest areas
☐ **Impacts on soil (wind erosion, compaction, contamination)** ➜ Loss of potential to support vegetation growth ➜ Areas permanently denuded of vegetation	– Proliferation of roads and tracks and loss of protective ed ground cover – Human excrement (contamination from inappropriate ablution facilities or a lack of ablution facilities)
☐ **Impacts on conservation** ☐ **Disturbances to fauna and flora** ☐ **Loss of endemic and protected species**	– Noise (vehicle movement, generators, general human activity) – Vandalism and ignorance – Poaching – Unsustainable hunting (game mammals) and harvesting (crayfish and shellfish) – Illegal collection of plant material and animals – Feeding of wild animals, resulting in the scavenging of waste by wild animals
☐ **Alien / invasive fauna and flora**	– Introduction of terrestrial fauna (e.g. mice) and plants (e.g. prickly pear) to picnic spots, rest areas and wilderness camps (the risks of terrestrial fauna and flora spreading are limited by harsh climatic conditions) – Introduction of aquatic fauna (e.g. fish species in the Orange River for angling) and flora (e.g. algae species introduced by watercraft)
☐ **Impacts on ground water (resource depletion, quality)** ➜ Ground water is a scarce resource. Very little recharge occurs in most parts of the Sperrgebiet. Any use of the resource means that the resource will be mined. ➜ Impacts on micro-habitats and biodiversity ➜ Water quality is generally poor. Hydraulic links to coast exist in places where water occurs in seeps and fountains, these support important micro-habitats	– Human excrement (contamination from inappropriate ablution facilities or a general lack of ablution facilities) – Fuel and vehicle lubricants – Indiscriminate water abstraction – Wastage of a scarce resource
☐ **Impacts on surface water (quality)**	– Water based activities (Orange River and coastal strip) – Fuel and lubricants from motorised boats and ferries
☐ **Visual impacts** (highly significant in a wilderness area with low visual absorption capacity and slow rate of recovery)	– Litter and waste – Incorrect siting of picnic sites, rest areas, wilderness camps – Proliferation of tracks – Lighting – Signs of human activity in a wilderness area

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Impact on heritage sites and artefacts (palaeontological, archaeological, historical, cultural)**	– Proliferation of tracks – Incorrect siting of picnic sites, rest areas, wilderness camps – Unconfined activities and access into sensitive areas – People tampering with or removing / collecting objects / vandalism and ignorance
☐ **Health and safety** ☐ **Risks and hazards**	– Harsh and unpredictable climatic conditions – Road safety – Hazardous fauna and flora (snakes, bees, black flies, etc.)
☐ **Cumulative impacts**	– Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment – Unsustainable hunting / harvesting of fauna and flora

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - Contractual commitment
  - Financial provision
  - Roles and responsibilities
- ☐ **Training and registration of tour operators / guides / support staff**
- ☐ **Benefits to local communities**
  - Employment
  - Use of local suppliers and service providers
- ☐ **Land use conflict**
  - Noise / impacts on wildlife
  - Trespassing and illegal access into restricted areas
  - Prospecting and mining
- ☐ **Roads and tracks**
  - Alignment
  - Haphazard and off-road driving
  - Dust and erosion
  - Maintenance
- ☐ **Pollution control**
  - Provision of ablution facilities (portable or fixed)
  - Disposal of fuels and lubricants (i.e. during breakdowns and emergency repairs)
- ☐ **Water abstraction, supply and transportation**
- ☐ **Power provision**
  - Gas / generators / solar
- ☐ **Litter and waste management**
  - Collection and disposal
- ☐ **Protecting the biophysical environment**
  - Protection of water resources, water consumption
  - Protective ground cover, topsoil
  - Erosion
  - Habitats and biodiversity
  - Endemic and protected species
  - Poaching and collection of animals and plant material
  - Invasive species
- ☐ **Protecting heritage sites and artefacts**
  - Cultural, historical, archaeological, palaeontological
- ☐ **Health and safety / public risks and hazards**
  - Unpredictable climatic conditions
  - Emergency situations
  - Evacuation procedures
  - Road safety

Key Constraints

- ☐ Sensitivity of the Sperrgebiet environment, especially with regards to the proliferation of tracks due to uncontrolled driving
- ☐ Land use conflicts, especially with prospecting, mining and power generation and transmission
- ☐ Low carrying capacity
- ☐ Remoteness of the area, lack of backup and emergency services
- ☐ Unpredictable climatic conditions and temperature extremes
- ☐ Scarcity of water resources and poor water quality
- ☐ Dust and sand storms / sandblasting of vehicles and equipment / sand concealing roads and tracks
- ☐ Lack of supporting infrastructure and services
- ☐ Current Sperrgebiet security restrictions and access control (i.e. lack of access to Orange River below Sendelingsdrift)
- ☐ Logistical problems with permits and security clearance (have to be applied for well in advance)
- ☐ Lack of established entrance gates and links with neighbouring parks (Huns Ai-Ais, Richtersveld and Namib-Naukluft Park)
- ☐ Lack of regional publicity and marketing campaigns (lack of funding)
- ☐ Vandalism and ignorance / cultural imperialism (tourists indifferent to local cultures and sensitivities)

Map 16: Scientific Research

(Amended; sources cited)

4. Conservation and Research

Sub-Sectors

- ☐ **Conservation**
  - ☐ Biodiversity
  - ☐ Heritage resources (cultural, historical, archaeological, palaeontological)

- ☐ **Scientific Research**
  - ☐ Fauna and flora (birds, seals, cetaceans, lichens, arachnids, invertebrates – terrestrial, intertidal and coastal islands)
  - ☐ Palaeontology/Archaeology
  - ☐ Geology

Areas of Opportunity

CONSERVATION:

WHAT:	HOW:	WHEN:
Sperrgebiet (sub-regional context)	– Declare the Sperrgebiet as a Protected Area under the forthcoming Wildlife and Parks Management Act. – Improve links with neighbouring conservation areas. – Manage the Sperrgebiet land use zones as described on page 55.	2000
Regional Park Network	– Establish a three-country international conservation area (South Africa, Namibia and Angola)	?

(See Map 10, page 67 and Map 11, page 71)

SCIENTIFIC RESEARCH:

The entire Sperrgebiet is important for Conservation and Research. Specific areas which urgently require further research are listed below.

WHERE:	WHY:	WHEN:
Coastal islands	– Important breeding areas – Lack of sufficient scientific information to determine the environmental importance and potential for complimentary land uses.	Prior to opening up the areas for any other land use
Core mining areas	– Investigate potential for rehabilitation and establishment of complimentary land uses	In progress

WHERE:	WHY:	WHEN:
Mountainous areas, Inselbergs, Orange River mouth and wetlands	– Biodiversity 'hotspots'. – Lack of sufficient scientific information to determine the environmental importance and potential for complimentary land uses.	Prior to opening up the areas for any other land use

(See Map 16, page 120)

Key Requirements and Inputs

- ☐ **Appropriate administrative framework**
- ☐ **Financial support / funding**
- ☐ **Qualified scientists, researchers and support staff**
- ☐ **Accommodation / staff quarters**
- ☐ **Accessibility**
  - – Roads and tracks
  - – Airstrip
  - – Security clearance to enter restricted areas
  - – Access into core wilderness areas by least intrusive form of transport
- ☐ **Transportation and equipment**
  - – 4x4 vehicles, helicopters
  - – Maps, GPS, radio, etc.
- ☐ **Water storage and transportation** (tanks / portable containers)
- ☐ **Waste management**
  - – Disposal
  - – Collection and temporary storage
- ☐ **Ablution amenities (sanitation, showers, etc.)**
  - – Portable (chemical toilets)
  - – Fixed systems (pit / french drain)
- ☐ **Power supply (solar / generator / gas)**
  - – Lighting
  - – Cooking
  - – Space heating
- ☐ **Fuel storage, transportation and transfer**
- ☐ **Supporting services (Rosh Pinah, Aus, Lüderitz, Oranjemund)**
  - – Water supply
  - – Fuel supply
  - – Garages / workshops
  - – Emergency services / health care
  - – Research centre / library / laboratory

Key Constraints

- ☐ Lack of sufficient funding
- ☐ Pressure for the establishment of other land uses
- ☐ Remoteness of the area, lack of backup and emergency services
- ☐ Unpredictable climatic conditions and temperature extremes
- ☐ Scarcity of water resources and poor water quality
- ☐ Dust and sand storms / sandblasting of vehicles and equipment / sand concealing roads and tracks
- ☐ Lack of supporting infrastructure and services
- ☐ Current Sperrgebiet security restrictions and access control
- ☐ Logistical problems with permits and security clearance
- ☐ Lack of linkages with neighbouring and regional conservation areas
- ☐ Dependability on international relations and political stability (for successful establishment of an international conservation area – regional park network)

Map 17: Agricultural Potential

(Amended; sources cited)

5. Irrigation Agriculture

Sub-Sectors

- ☐ **Irrigated Agriculture**
  - ➔ High-value crops

Areas of Opportunity

WHAT:	WHY:	WHERE:	WHEN:
High-value crops	Sperrgebiet climatic conditions preclude low-value crops.	Northern bank of the Orange River	After completion of feasibility studies and / or after mining ceases in 2020.

(See Map 17, page 123)

Major Activities

- ☐ **Feasibility investigation**
  - – Soil sampling
  - – Water sampling
  - – Air photo interpretation
  - – Agricultural trials
- ☐ **Obtaining permits for water abstraction**
- ☐ **Establishment**
- ☐ **Operation**
  - – Planting
  - – Harvesting
  - – Production (value adding)
  - – Transportation of produce

Key Requirements and Inputs

- ☐ **Amenable climate**
- ☐ **Availability of irrigation water**
- ☐ **Permits for water abstraction**
- ☐ **Marketability**
- ☐ **Agricultural trials**
- ☐ **Access roads and tracks**
- ☐ **Water abstraction and supply**
  - – Irrigation water
  - – Potable water
- ☐ **Water storage (reservoir / tanks)**
- ☐ **Ablution amenities**
  - – Sanitation
  - – Taps, showers
- ☐ **Accommodation and offices**
- ☐ **Storage sheds (prefabs)**

- ☐ **Vehicles and Equipment**
  - 4x4 vehicles
  - Pumps
  - Tractors
  - Implements
  - Irrigation equipment
- ☐ **Waste disposal**
- ☐ **Power supply**
  - Irrigation
  - Lighting, cooking, etc.
- ☐ **Fuel supply**
- ☐ **Labour**
- ☐ **Supporting services**
  - Health care
  - Banking
  - Fuel supply
  - Post and telecommunications
  - Waste disposal
  - Accommodation
  - Recreation facilities
  - Workshops / garages
  - Air strip
  - Shops

Key Residues and Emissions

- ☐ **Construction and Demolition Rubble**
  - Concrete slabs, pump installations
- ☐ **Sewage and Waste Water**
- ☐ **General Waste**
  - Food scraps, paper, board, wood, plastic, glass, other
- ☐ **Industrial / Hazardous Waste**
- ☐ **Agro-chemical run-off and infiltration**
  - Used chemicals, lubricants, oil and vehicle fluids, scrap metal, fertilizers, etc.
- ☐ **Dust**
- ☐ **Visual Pollution**
  - Litter and Waste
  - Lighting
  - Roads and Tracks
  - Campsite
  - Storage

Issues for inclusion in an EA

- ☐ Baseline environmental conditions and levels of existing damage and pollution
- ☐ Project description
- ☐ Potential environmental impacts and issues
- ☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Loss of protective ground cover** (highly significant in arid environments with very slow recovery rates) ➜ Loss of habitats ➜ Impacts on biodiversity ➜ Loss of endemic and protected species	– Disturbances to the fragile desert pavement and vegetation, vegetation removal – Incorrect siting of project and its components – and unconfined activities – Proliferation of tracks – Excessive vehicle movement
☐ **Impacts on soil (chemical composition, erosion, compaction)** ➜ Nutrient depletion ➜ Increased salinity levels ➜ Loss of potential to support vegetation growth ➜ Areas permanently denuded of vegetation	– Loss of protective ground cover – Movement of vehicles – Exposure of soil and stockpiles to wind erosion – Loss of topsoil and natural seedbank – Contamination from ablution facilities and hazardous substances – Loss of soil fertility due to unsustainable farming methods – Use of fertilisers, herbicides and pesticides

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Dust** ➜ Formation of dunelets ➜ Movement of large quantities of sand ➜ Limits plant growth	– Use of vehicles and farming equipment – Loss of protective ground cover (this can cause problems even over small areas and is not to be underestimated) – Disturbances to top layer of soil
☐ **Noise** ➜ Land use conflict – intrusion on nearby tourist activities and accommodation establishments (not problematic at present but would impact on future tourism developments) ➜ Disturbances to fauna (chasing away animals)	– Vehicle movement – Generators, compressors, farming equipment – Pumps – Human activity
☐ **Impacts on fauna** ➜ Loss of biodiversity ➜ Loss of endemic and protected species ➜ Impact on Ramsar site	– Loss of habitats – Noise – Soil handling, affecting ground living organisms (i.e. *psammophilous* spp.) – Use of herbicides and pesticides
☐ **Alien / invasive species**	– Introduction of alien / invasive fauna (e.g. mice) and plants (e.g. prickly pear)
☐ **Impacts on ground water and surface water (resource depletion, quality)** ➜ Impacts on micro-habitats and biodiversity ➜ Increase in salinity levels. ➜ Water is a scarce resource. ➜ Very little ground water recharge occurs in most parts of the Sperrgebiet. Any use of the ground water resources means that the resource will be mined.	– Irrigation return flows – Use of fertilisers, herbicides and pesticides – Contaminants entering stream channels and underground aquifers – Indiscriminate water abstraction – Wastage of a scarce resource
☐ **Visual impacts** (highly significant in a wilderness area with low visual absorption capacity and slow rate of recovery) ➜ Land use conflict – intrusion on nearby tourist activities and accommodation establishments (not problematic at present but would impact on future tourism developments)	– Proliferation of tracks – Lighting – Signs of human activity in a wilderness area
☐ **Impact on heritage sites and artefacts (palaeontological, archaeological, historical, cultural)**	– Incorrect siting of project components – Unconfined activities – Proliferation of tracks
☐ **Social structures** ☐ **Health and safety** ☐ **Risks and hazards**	– Employment conflict, influx of jobseekers – Spreading of HIV / AIDS – Road safety – Working conditions – Public safety
☐ **Cumulative impacts**	– Loss of soil fertility over time – Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - Contractual commitment
  - Financial provision
  - Roles and responsibilities
  - Monitoring
- ☐ **Environmental awareness**
  - Environmental code of conduct
  - Training programme
- ☐ **Employment / social structures**
  - Recruitment
  - Employment conflict
  - Demographics
  - Influx of jobseekers
- ☐ **Public relations / land use conflict**
  - Noise
  - Aesthetics
  - Illegal access into restricted areas
- ☐ **Site establishment**
  - Siting and utilisation of project components
- ☐ **Roads and tracks**
  - Alignment
  - Dust, erosion
  - Haphazard and off-road driving
  - Maintenance
  - Road safety
- ☐ **Soil management**
  - Drainage, puddling and erosion
  - Capping
  - Compaction
  - Salinity (salt movement / build-up)
  - Dust
- ☐ **Use of fertilisers, herbicides and pesticides**
- ☐ **Habitats and biodiversity**
- ☐ **Air quality**
- ☐ **Alternative irrigation methodologies and management measures**
  - Flood
  - Overhead sprinkler
  - Gantry type (circular or rectangular)
  - Micro-jet
  - Drip
- ☐ **Water management**
  - Permits
  - Abstraction
  - Evaporation
  - Evapotranspiration
- ☐ **Pollution control and handling of hazardous substances**
  - Pollution
  - Health
- ☐ **Landscape quality**
  - Visual intrusion and degradation
  - Tourism potential
- ☐ **Litter and waste management**
  - Minimisation, recycling
  - Collection
  - Treatment
  - Storage
  - Transportation
  - Disposal
- ☐ **Protecting heritage sites and artefacts**
  - Cultural
  - Historical
  - Archaeological
  - Palaeontological
- ☐ **Health and safety**
  - Harsh climatic conditions
  - HIV / AIDS
  - Occupational risks and hazards
  - Public risks and hazards
  - Protective ground cover, topsoil

Key Constraints

- ☐ Questionable availability of irrigation water, limited water allocations from Orange River
- ☐ Land use conflict, especially with diamond mining requirements
- ☐ Lack of concrete information on the marketability and financial competitiveness (feasibility studies)
- ☐ Remoteness of area, high transportation costs and long distances to markets
- ☐ Harsh climatic conditions, seriously limiting the selection of crops, only high-value crops will be viable
- ☐ Unpredictable climatic conditions
- ☐ Current Sperrgebiet security regulations and access control
- ☐ Lack of supporting infrastructure and services
- ☐ Sensitivity of the Sperrgebiet environment, especially with regards to the proliferation of tracks due to uncontrolled driving

6. Mariculture and Aquaculture

Sub-Sectors

- ☐ **Fish**
- ☐ **Shellfish**
- ☐ **Seaweed**

Areas of Opportunity

FISH:

WHERE:	WHO:	WHEN:	HOW:	WHY:
Oranjemund	Bolton Industrial	Proposed	Land-based farming of marine species	Sale of fish for consumption in European markets

(See Map 18, Infrastructure and Development, page 132)

Major Activities

- ☐ **Construction**
  - Tanks / dams
  - Stock culturing facilities
  - Processing and handling facilities
  - Cooling / freezing facilities
  - Offices
  - Accommodation and associated amenities
  - Services (power lines, potable water supply)
  - Pipelines for water abstraction, waste water disposal
  - Waste disposal facilities
- ☐ **Operation**
  - Water abstraction
  - Feed supply (associated agriculture)
  - Filtering of tanks
  - Aeration of tanks
  - Culturing of stock
  - Waste water disposal
  - Processing of product (cleaning, smoking, freezing / packaging)
  - Transportation of product
  - Solid waste disposal
  - Staff accommodation and offices
- ☐ **Decommissioning**
- ☐ **Demolition / sale of infrastructure**
- ☐ **Rehabilitation and revegetation**

Key Requirements and Inputs

- ☐ **Dams / tanks**
- ☐ **Aeration and filtering facilities**
- ☐ **Stock culturing facilities**
- ☐ **Water abstraction (pipeline from ocean or river**
- ☐ **Waste water treatment and disposal**
- ☐ **Processing and handling facilities**
  - cleaning / filleting / agar extraction / smoking / freezing / packaging
- ☐ **Offices, workshops, accommodation and amenities**
- ☐ **Fish feed (associated agriculture / external supply)**
- ☐ **Transport**
- ☐ **Access roads**
- ☐ **Waste disposal**
  - Putrescibles (offal)
  - Hazardous
  - Sewage
  - General
- ☐ **Power supply (power line / generator)**
- ☐ **Potable water supply and reticulation**
- ☐ **Labour**
- ☐ **Supporting services**
  - Fuel
  - Banking
  - Post and telecommunications
  - Shops
  - Workshops, garages
  - Accommodation

Key Residues and Emissions

- ☐ **Odours**
- ☐ **Sludge**
- ☐ **Putrescible organic matter (offal)**
- ☐ **Waste Water**
- ☐ **Spillage / unplanned Discharge**
- ☐ **Noise**
- ☐ **General Waste**
- ☐ **Sewage**

Issues for inclusion in an EA

- ☐ Baseline environmental conditions and level of existing damage and pollution
- ☐ Project description
- ☐ Potential environmental impacts and issues
- ☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Loss of indigenous vegetation** ➜ Loss of endemic and protected species ➜ Loss of habitat	– Construction of farming facilities – Construction of processing and handling facilities – Construction of infrastructure for water abstraction (pipelines / boreholes) – Construction of access roads
☐ **Impacts on fauna** ➜ Loss of habitat ➜ Disturbance of exiting populations	– Construction of facilities – Mariculture and aquaculture will attract sea birds
☐ **Impacts on surface water** ➜ Reduction in quantity of water due to freshwater abstraction from rivers ➜ Reduction in quality of surface water due to effluent release into rivers	– Surface water abstraction for use in processing and handling facilities – Surface water abstraction for use as potable water – Accidental discharge from cultivation dams / tanks – Effluent from cultivation facilities. – Effluent from processing and handling facilities

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Impacts on ground water** ➜ Reduction in quantity of water due to freshwater abstraction from boreholes ➜ Reduction in quality of ground water due to effluent release into groundwater system	– Ground water abstraction for use in processing and handling facilities – Ground water abstraction for use as potable water – Accidental discharge from land-based cultivation dams / tanks into groundwater system – Sewage treatment facilities
☐ **Noise** ➜ Disturbance to nearby settlements ➜ Disturbance of fauna	– Pumps (e.g. aerators, abstraction pumps, aerators, effluent pumps, filtering systems) – Generators – Vehicle movement – Human activity
☐ **Air quality** ➜ Odours ➜ Airborne emissions	– Seaweed drying – Tank / dams – Processing and handling facilities (e.g. agar extraction, waste, smoking facilities)
☐ **Alien / invasive species** ➜ Introduction of exotic species into natural systems ➜ Introduction of invasive species	– Accidental release of exotic species from cultivation facilities – Disturbance of land provides opportunities for establishment of invasive species
☐ **Visual impacts** (highly significant in a wilderness area with low visual absorption capacity and slow rate of recovery) ➜ Land use conflict – intrusion on nearby tourist activities and accommodation establishments (not problematic at present but could impact on future tourism developments)	– Infrastructure – Litter and waste – Lighting – Human activity in natural areas
☐ **Impact on heritage sites and artefacts (palaeontological, archaeological, historical, cultural)**	– Incorrect siting of cultivation, processing and handling facilities – Access roads
☐ **Social structures** ☐ **Health and safety** ☐ **Risks and hazards**	– Employment conflict, influx of jobseekers – Spreading of HIV / AIDS – Road safety – Working conditions (e.g. diving) – Public safety
☐ **Cumulative impacts**	– Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - Contractual commitment
  - Financial provision
  - Roles and responsibilities
  - Penalties / incentives
  - Monitoring
- ☐ **Environmental awareness**
  - Environmental code of conduct
  - Training programme
- ☐ **Employment / social structures**
  - Recruitment
  - Employment conflict
  - Demographics
  - Influx of jobseekers
- ☐ **Public relations / land use conflict**
  - Noise
  - Odour
  - Aesthetics
  - Information dissemination
  - Complaints and grievances
  - Trespassing
  - Illegal access into restricted areas
- ☐ **Site establishment**
  - Siting of cultivation, processing and handling facilities.
  - Siting of pipelines
- ☐ **Roads**
  - Alignment
  - Dust, erosion
  - Haphazard and off-road driving
  - Maintenance
  - Road safety
- ☐ **Pollution control and handling of hazardous substances**
  - Effluent
  - Putrescibles (offal)
- ☐ **Litter and waste management**
  - Minimisation, recycling
  - Collection treatment
  - Storage
  - Transportation
  - Disposal
- ☐ **Protecting the biophysical environment**
  - Surface water
  - Ground water
  - Ocean
  - Habitats and biodiversity
  - Endemic and protected species
  - Exotic and invasive species
  - Air quality
  - Landscape quality
- ☐ **Visual intrusion and degradation**
  - Tourism potential
- ☐ **Protecting heritage sites and artefacts**
  - Cultural
  - Historical
  - Archaeological
  - Palaeontological
- ☐ **Health and safety**
  - Harsh climatic conditions
  - HIV / AIDS
  - Occupational risks and hazards
  - Public risks and hazards
- ☐ **Decommissioning**
  - Restoration and rehabilitation

Key Constraints

- ☐ Scarcity of water resources
- ☐ Protected areas and areas of conservation importance
- ☐ Construction of salt water abstraction and discharge structures within the high energy surf zone
- ☐ Lack of technology and expertise in mariculture
- ☐ Sensitivity of the Sperrgebiet environment, importance of the area for conservation and research
- ☐ Land use conflicts, especially with potential tourism developments
- ☐ Remoteness of the area
- ☐ Harsh climatic conditions
- ☐ Lack of supporting infrastructure and services
- ☐ Current Sperrgebiet security regulations and access control

Map 18: Infrastructure and Development

(Amended; sources cited)

7. Power Generation and Transmission

Sub-Sectors

- ☐ **Power Generation**
  - ☐ Natural gas power plant
  - ☐ Wind park
  - ☐ Solar power
- ☐ **Power Transmission**

Areas of Opportunity

NATURAL GAS POWER PLANT:

WHERE:	WHO:	WHEN:	HOW:	WHY:
Oranjemund	Independent Power Producer	2002 – ?	Combined Cycle Gas Turbine Power Plant	Natural gas from the Kudu Gas Field located 170 km offshore can contribute to the Namibian power grid

(See Map 18: Infrastructure and Development, page 132)

WIND PARKS:

WHERE:	WHO:	WHEN:	HOW:	WHY:
Grossebucht (south of Lüderitz)	NamPower and MME	2001	Wind Energy Converters	Future development will depend on results from Pilot Plant Cleaner air technology

(See Map 18: Infrastructure and Development, page 132)

SOLAR POWER:

WHERE:	WHO:	WHEN:	HOW:	WHY:
East of the fog zone (50 km inland from coastline)	Tourist Facilities Prospectors Mines Boreholes	?	Photovoltaics Use light of the sun to generate electricity	High proportion of sunshine in eastern parts of the Sperrgebiet

TRANSMISSION LINES:

WHERE:	WHO:	WHEN:	SIZE:	WHY:
Obib substation to Oranjemund	NamPower		400 kV	Link power from Kudu Gas Plant to Namibian grid
Oranjemund to Kudu Gas Power Station	NamPower	?	2 X 400 kV	
Obib substation to Skorpion Zinc Mine	NamPower	?	2 x 66 kV	Supply power to the Skorpion Zinc Mine
Section of power line linking Obib substation to Kokerboom substation near Keetmanshoop falls into Sperrgebiet	NamPower	?	400 kV	Link power form Kudu Gas Plant to Namibian grid
Section of power line from Obib substation to Rosh Pinah falls into Sperrgebiet	NamPower	?	66 kV	Supply power to Rosh Pinah
Oranjemund to Oranjemond substation (RSA Power Grid)	NamPower	?	220 kV	Link to RSA grid
Wind Park at Grossebucht to Lüderitz 66/11 kV substation	NamPower and MME	2001-2020	66 kV	Link wind park to Namibian grid
Power lines from Namibian grid to mine sites	See opportunities for mining	?	?	Power supply for mining activities
Power lines to mariculture and aquaculture facilities	See opportunities for mariculture and aquaculture	?	?	Power supply for operations

(See Map 18: Infrastructure and Development, page 132)

NATURAL GAS POWER PLANT:

Major Activities

- ☐ **Construction**
  - Site clearance
  - Site excavation and concreting
  - Erection of superstructures
  - Erection of infrastructure
  - Mechanical and electrical installation
- ☐ **Operation**
  - Generation of electricity using natural gas (gas and steam turbines)
  - Generation of electricity using secondary fuel (liquid fuel oil) when gas is unavailable
- ☐ **Decommissioning**
  - Demolition
  - Rehabilitation

Key Requirements and Inputs

- ☐ **Natural gas**
  - Offshore gas pipeline
  - Onshore gas pipeline
  - Gas conditioning plant
- ☐ **Liquid fuel oil (secondary supply of liquid fuel)**
  - Offshore buoy facilities for oil supplied by ship
  - Liquid fuel oil pipeline
  - On-site oil storage facilities
- ☐ **Power plant**
  - Gas turbine
  - Heat recovery steam generator and associated chimneys
  - Steam turbine and cooling system
  - Electrical generator
- ☐ **Water abstraction for cooling system** *(river water / sea water)*
  - Intake structures
  - Defouling agents
- ☐ **Water abstraction for fire protection, domestic and general purposes (river / borehole)**
- ☐ **Access for equipment and materials for construction**
- ☐ **Transportation**
  - Transport via ship
  - Transport via road
- ☐ **Offices and associated amenities**
- ☐ **Effluent discharge (pipeline)**
- ☐ **Sewage treatment**
- ☐ **Waste disposal**
  - General
  - Hazardous
  - Industrial
- ☐ **Labour**
- ☐ **Supporting services**
  - Health care
  - Education
  - Banking
  - Fuel supply
  - Post and telecommunications
  - Accommodation
  - Recreation facilities
  - Workshops / garages
  - Roads
  - Air strip
  - Shops

Key Residues and Emissions

- ☐ **Heat Energy**
- ☐ **Gaseous Emissions**
  - Carbon dioxide
  - Nitrogen oxides
  - Sulphur dioxide
  - Water vapour
  - Particulate matter
- ☐ **Noise**
- ☐ **Industrial / Hazardous Waste**
  - General
  - Industrial / Hazardous
  - Sewage
- ☐ **Dust**

☐ **Effluent**
- Cooling water discharge (thermal pollution)
- Boiler blowdown
- Gas turbine blade cleaning effluent
- Station drainage
- Sewage treatment plant effluent
- Station surface water drainage Steam generator chemical cleaning effluent

Issues for inclusion in an EA

☐ Baseline environmental conditions and levels of existing damage and pollution
☐ Project Description
☐ Potential environmental impacts and issues
☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Loss of protective ground cover** Highly significant in arid environments with very slow recovery rates ➔ Loss of habitats ➔ Impacts on biodiversity ➔ Loss of endemic and protected species	– Disturbance to the fragile desert pavement and vegetation – Site clearance and excavation for plant and associated infrastructure – Sourcing of construction materials (borrow pits) – Incorrect siting of power plant and associated infrastructure
☐ **Impacts on soil (chemical composition, erosion, compaction)** ➔ Loss of soil nutrients ➔ Loss of potential to support vegetation growth ➔ Areas permanently denuded of vegetation	– Loss of protected ground cover – Loss of agricultural potential – Exposure of soil and stockpiles to wind erosion – Loss of topsoil and natural seedbank – Contamination from oil storage facilities
☐ **Impacts on air quality** ➔ Gaseous emissions ➔ Dust	– Release of carbon dioxide – Release of nitrogen oxides – Release of sulphur dioxide due to the burning of liquid fuel oil – Dust produced during construction (earthworks, exposed sand, traffic)
☐ **Noise**	– Construction equipment – Vehicles – Ancillary equipment at power plant (e.g. transformers, water pumps, gas heaters)
☐ **Impacts on fauna** ➔ Loss of biodiversity ➔ Loss of endemic and protected species	– Disposal of effluent – Changes in water temperature due to discharge of cooling waters – Loss of habitat – Disturbance due to lighting and noise – Impact of power lines
☐ **Loss of indigenous vegetation**	– Vegetation removal for construction of infrastructure – Acid rain or acidic fog
☐ **Impact on heritage sites and artefacts (palaeontological, archaeological, historical, cultural)**	– Incorrect siting of plant and associated infrastructure (e.g. pipelines, roads, power lines, housing)
☐ **Alien / invasive species** (risks of spreading limited by harsh climatic conditions)	– Disturbance of land promotes establishment of alien / invasive plant species – Introduction of alien / invasive species
☐ **Impacts on ground water (resource depletion, quality)**	– Contaminants entering underground aquifers – Indiscriminate water abstraction – Wastage of a scarce resource

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Visual impacts**	– Lighting – Power lines – Chimneys, cooling towers, tanks and other tall superstructures
☐ **Social structures** ☐ **Health and safety** ☐ **Risks and hazards**	– Employment conflict, influx of jobseekers – Spreading of HIV / AIDS – Road safety – Working conditions – Public safety and security
☐ **Cumulative impacts**	– Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - Contractual commitment
  - Financial provision
  - Roles and responsibilities
  - Penalties / incentives
  - Monitoring
- ☐ **Environmental awareness**
  - Environmental code of conduct
  - Training programme
- ☐ **Employment / social structures**
  - Recruitment
  - Employment conflict
  - Demographics
  - Influx of jobseekers
- ☐ **Public relations / land use conflict**
  - Noise
  - Air pollution
  - Aesthetics
  - Information dissemination
  - Complaints and grievances
  - Trespassing
  - Illegal access into restricted areas
- ☐ **Site establishment**
  - Siting of power plant
  - Siting of infrastructure (pipelines, roads, power lines etc.)
  - Siting of housing
- ☐ **Pollution control and handling of hazardous substances**
  - Effluent release
  - Gaseous emissions
  - Storage and handling of hazardous substance (e.g. Liquid petroleum oil)
- ☐ **Solid waste management**
  - Minimisation, recycling
  - Collection
  - Treatment
  - Storage
  - Transportation
  - Disposal
- ☐ **Protecting the biophysical environment**
  - Air quality
  - Water resources, water consumption
  - Protective ground cover, topsoil
  - Erosion
  - Habitats and biodiversity
  - Endemic and protected species
  - Rescue operations
  - Poaching and collection of animals and plant material
  - Invasive species
- ☐ **Landscape quality**
  - Visual intrusion and degradation
  - Tourism potential
- ☐ **Protecting heritage sites and artefacts**
  - Cultural
  - Historical
  - Archaeological
  - Palaeontological
- ☐ **Health and safety**
  - Harsh climatic conditions
  - HIV / AIDS
  - Occupational risks and hazards
  - Public risks and hazards
- ☐ **Decommissioning**
  - Restoration and rehabilitation

WIND PARKS:

Major Activities

- ☐ **Construction**
  - Site clearance
  - Erection of towers, transformers and wind energy converters
  - Construction of access roads
  - Construction of power lines
- ☐ **Operation**
  - Maintenance
- ☐ **Decommissioning**
  - Demolition
  - Rehabilitation

Key Requirements and Inputs

- ☐ **Wind**
- ☐ **Construction materials**
  - Transport
  - Raw and intermediate materials
  - Hazardous materials
- ☐ **Construction sites**
  - Power (generator / gas)
  - Potable water abstraction / supply
  - Accommodation (prefabs /caravans / tents)
  - Ablution facilities
  - Stores, workshops and wash-bays
- ☐ **Vehicles and construction equipment**
- ☐ **Fuel**
- ☐ **Facilities and services**
  - Water
  - Power supply
  - Ablution amenities
  - Health services
- ☐ **Waste disposal**
  - Waste containers
  - Pits
  - Removal
- ☐ **Labour**
  - Skilled
  - Unskilled
- ☐ **Access to site**
- ☐ **Market for power**
  - Roads and tracks

Key Residues and Emissions

- ☐ **Effluent from wash-bays**
- ☐ **Hazardous Waste**
  - Sewage
  - Paints, solvents
  - Fuel, oils and grease
- ☐ **Dust**
- ☐ **General Waste**
  - Construction rubble
  - Scrap
  - Redundant equipment
  - Litter
  - Food scraps
  - Paper and cardboard
  - Wood scraps

Issues for inclusion in an EA

- ☐ Baseline environmental conditions and levels of existing damage and pollution
- ☐ Project description
- ☐ Potential environmental impacts and issues
- ☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Loss of protective ground cover** Highly significant in arid environments with very slow recovery rates ➔ Loss of habitats ➔ Impacts on biodiversity ➔ Loss of endemic and protected species	– Disturbance to the fragile desert pavement and vegetation, vegetation removal – Site clearance and excavation for infrastructure – Sourcing of construction materials (borrow pits) – Incorrect siting of wind park and associated infrastructure – Proliferation of tracks – Excessive vehicle movement
☐ **Impacts on soil (chemical composition, erosion, compaction)** ➔ Loss of soil nutrients ➔ Loss of potential to support vegetation growth ➔ Areas permanently denuded of vegetation	– Loss of protected ground cover – Movement of heavy vehicles – Exposure of soil and stockpiles to wind erosion – Loss of topsoil and natural seedbank – Contamination from ablution facilities and hazardous substances (oil spillages, effluent from wash bays) – Uncontrolled storage and dumping of waste products
☐ **Impacts on air quality** ➔ Dust	– Movement of vehicles – Earthworks and excavations (e.g. drilling, grading) – Loss of protective ground cover – Disturbances of top layer of soil – Wind erosion of stock piles
☐ **Shadow and noise**	– Construction equipment (e.g. drilling, welding) – Vehicles – Shadow flicker – Transformers
☐ **Impacts on fauna** ➔ Loss of biodiversity ➔ Loss of endemic and protected species	– Loss of habitat – Disturbance by construction activity – Impacts on birds (migration routes, disturbance of breeding places and forage location, collisions with turbines)
☐ **Loss of indigenous vegetation**	– Incorrect siting of wind park and associated infrastructure (e.g. access roads, tracks, power lines) – Vegetation removal for construction of infrastructure – Removal of plants of conservation importance Collection of plant material (poaching, wood collection)
☐ **Impact on heritage sites and artefacts palaeontological, archaeological, historical, cultural**	– Incorrect siting of wind park and associated infrastructure (e.g. access roads, tracks, power lines) – Disturbance due to activities surrounding construction sites
☐ **Alien / invasive species** Risks of spreading limited by harsh climatic conditions	– Disturbance of land promotes establishment of alien / invasive plant species – Introduction of alien / invasive species
☐ **Impacts on ground water (resource depletion, quality)**	– Indiscriminate water abstraction at construction site – Contamination of underground aquifers due to ablution facilities and hazardous substances (oil spillages, effluent from wash bays) – Uncontrolled storage and dumping of waste products including PCBs – Wastage of a scarce resource
☐ **Impacts on surface water**	– Contaminants entering water courses – Siltation due to soil erosion
☐ **Visual impacts**	– Towers and wind energy convertors – Proliferation of roads and racks – Human activity in a wilderness area

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Social structures** ☐ **Health and safety** ☐ **Risks and hazards**	– Employment conflict, influx of jobseekers – Spreading of HIV / AIDS – Road safety – Aviation – Working conditions – Public safety and security
☐ **Cumulative impacts**	– Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - – Contractual commitment
  - – Financial provision
  - – Roles and responsibilities
  - – Penalties / incentives
  - – Monitoring
- ☐ **Environmental awareness**
  - – Environmental code of conduct
  - – Training programme
- ☐ **Employment / social structures**
  - – Recruitment
  - – Employment conflict
  - – Demographics
  - – Influx of jobseekers
- ☐ **Public relations / land use conflict**
  - – Noise
  - – Air pollution
  - – Aesthetics
  - – Information dissemination
  - – Complaints and grievances
  - – Trespassing
  - – Illegal access into restricted areas
- ☐ **Site establishment**
  - – Siting of wind park
  - – Siting of access roads and tracks
  - – Siting of power lines
- ☐ **Pollution control and handling of hazardous substances**
  - – Pollution
- ☐ **Solid waste management**
  - – Minimisation, recycling
  - – Collection
  - – Treatment
  - – Storage
  - – Transportation
  - – Disposal
- ☐ **Protecting the biophysical environment**
  - – Air quality
  - – Water resources, water consumption
  - – Protective ground cover, topsoil
  - – Erosion
  - – Habitats and biodiversity
  - – Endemic and protected species
  - – Rescue operations
  - – Poaching and collection of animals and plant material
  - – Invasive species
- ☐ **Landscape quality**
  - – Visual intrusion and degradation
  - – Tourism potential
- ☐ **Protecting heritage sites and artefacts**
  - – Cultural
  - – Historical
  - – Archaeological
  - – Palaeontological
- ☐ **Health and safety**
  - – Harsh climatic conditions
  - – HIV / AIDS
  - – Occupational risks and hazards
  - – Public risks and hazards
- ☐ **Decommissioning**
  - – Restoration and rehabilitation

TRANSMISSION LINES:

Major Activities

- ☐ **Construction**
  - – Route clearance and blading
  - – Erection of pylons and substations
  - – Contractors camps
- ☐ **Operation**
  - – Maintenance of power lines and substations
- ☐ **Decommissioning**
  - – Demolition
  - – Rehabilitation

Key Requirements and Inputs

- ☐ **Construction materials**
  - – Borrow pits for road construction
  - – Materials for construction of pylons, transmission lines and substations
- ☐ **Construction camps**
  - – Power (generator / gas)
  - – Potable water abstraction / supply
  - – Accommodation (prefabs / caravans / tents)
  - – Ablution amenities (sanitation, showers)
  - – Vehicles and construction equipment
  - – Waste disposal
  - – Waste containers
  - – Pits
  - – Labour
- ☐ **Access roads and tracks**
  - – During construction
  - – Maintenance

Key Residues and Emissions

- ☐ **Construction Waste**
  - – Construction rubble
  - – Waste concrete
- ☐ **General Waste from Construction site**
  - – Litter
  - – Food scraps
  - – Paper and cardboard
  - – Wood scraps
- ☐ **Hazardous Waste**
  - – Sewage
  - – Pesticides
  - – Paints, solvents
  - – Fuel, grease, lubrication oils, hydraulic and brake fluid
- ☐ **Dust**

Issues for inclusion in an EA

- ☐ Baseline environmental conditions and levels of existing damage and pollution
- ☐ Project description
- ☐ Potential environmental impacts and issues
- ☐ Recommendations for mitigation of significant environmental impacts

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Loss of protective ground cover** (highly significant in arid environments with very slow recovery rates) ➔ Loss of habitats ➔ Impacts on biodiversity ➔ Loss of endemic and protected species	– Disturbances to the fragile desert pavement and vegetation, vegetation removal – Route clearance and blading – Incorrect siting of transmission route, track and maintenance roads – Proliferation of tracks – Excessive vehicle movement

KEY IMPACTS:	KEY IMPACT SOURCES:
☐ **Impacts on soil (chemical composition, erosion, compaction)** ➔ Loss of soil nutrients ➔ Loss of potential to support vegetation growth ➔ Areas permanently denuded of vegetation	– Loss of protective ground cover – Movement of heavy vehicles – Exposure of soil to wind erosion – Loss of topsoil and natural seedbank – Contamination from ablution facilities and hazardous substances during construction
☐ **Impacts on air quality** ➔ Dust	– Movement of vehicles – Earthworks and excavations (drilling, grading) – Loss of protective ground cover – Disturbances of top layer of soil – Wind erosion of stockpiles
☐ **Noise**	– Construction equipment (e.g. drilling, welding) – Vehicles
☐ **Impacts on fauna** ➔ Loss of biodiversity ➔ Loss of endemic and protected species	– Loss of habitat – Poaching by construction teams – Bird collisions with transmission lines – Removal of fences allowing escape of livestock
☐ **Loss of indigenous vegetation**	– Incorrect route selection – Incorrect siting of access roads and construction sites – Removal of ground cover due to blading – Removal of plants of conservation importance – Collection of plant material by construction workers
☐ **Impact on heritage sites and artefacts (palaeontological, archaeological, historical, cultural)**	– Incorrect route selection – Incorrect siting of access roads and construction sites – Disturbance during route clearance and blading – Tracks and service routes – Disturbance to site due to activities surrounding construction campsites
☐ **Alien / invasive species** Risks of spreading limited by harsh climatic conditions	– Disturbance of land promotes establishment of alien / invasive plant species – Introduction of alien / invasive species to construction campsites
☐ **Impacts on ground water (resource depletion, quality)**	– Indiscriminate water abstraction at construction sites – Contaminants entering underground aquifers – Wastage of scarce resource
☐ **Impacts on surface water**	– Contaminants entering water courses – Siltation due to soil erosion
☐ **Visual impacts**	– Pylons and transmission lines in wilderness area – Proliferation of roads and tracks
☐ **Social structures** ☐ **Health and safety** ☐ **Risks and hazards**	– Employment conflict, influx of jobseekers – Spreading of HIV / AIDS – Road safety – Working conditions – Public safety and security
☐ **Cumulative impacts**	– Increased user intensity – Low visual absorption capacity – Low carrying capacity – Low potential for assimilation of impacts and environmental damage – Slow recovery rates in arid environment

Key Elements of an EMP

- ☐ **Compliance with the EMP**
  - Contractual commitment
  - Financial provision
  - Roles and responsibilities
  - Penalties / incentives
  - Monitoring
- ☐ **Environmental awareness**
  - Environmental code of conduct
  - Training programme
- ☐ **Employment / social structures**
  - Recruitment
  - Employment conflict
  - Demographics
  - Influx of jobseekers
- ☐ **Public relations / land use conflict**
  - Noise
  - Aesthetics
  - Information dissemination
  - Complaints and grievances
  - Trespassing
  - Illegal access into restricted areas
- ☐ **Site establishment**
  - Siting of transmission route
  - Siting of construction campsites
  - Siting of access and maintenance roads
- ☐ **Roads and tracks**
  - Alignment
  - Dust, erosion
  - Haphazard and off-road driving
  - Maintenance
  - Road safety
- ☐ **Pollution control and handling of hazardous substances**
  - Pollution
- ☐ **Solid waste management**
  - Minimisation, recycling
  - Collection
  - Treatment
  - Storage
  - Transportation
  - Disposal
- ☐ **Protecting the biophysical environment**
  - Air quality
  - Water resources, water consumption
  - Protective ground cover, topsoil
  - Erosion
  - Habitats and biodiversity
  - Endemic and protected species
  - Rescue operations
  - Poaching and collection of animals and plant material
  - Invasive species
- ☐ **Landscape quality**
  - Visual intrusion and degradation
  - Tourism potential
- ☐ **Protecting heritage sites and artefacts**
  - Cultural
  - Historical
  - Archaeological
  - Palaeontological
- ☐ **Health and safety**
  - Harsh climatic conditions
  - HIV / AIDS
  - Occupational risks and hazards
  - Public risks and hazards
- ☐ **Decommissioning**
  - Restoration and rehabilitation

Key Constraints

- ☐ Sensitivity of the Sperrgebiet environment, importance of the area for conservation and research
- ☐ Expense of wind power and solar power generation as compared to coal and gas
- ☐ Proximity of the Ramsar site and the proposed Orange River Mouth Wetland Park to the Kudu Gas Power Plant
- ☐ Power purchase agreement between NamPower and ESKOM (RSA) and access to cheap energy supplied from South African grid
- ☐ Flooding of the Orange River
- ☐ Land use conflicts, especially with potential tourism developments
- ☐ Remoteness of the area
- ☐ Construction of water abstraction / discharge pipelines in the high energy surf zone required for Kudu Gas Power Plant
- ☐ Harsh climatic conditions
- ☐ Maintenance costs (corrosion by sea spray, abrasion by wind, offshore natural gas pipeline maintenance)
- ☐ Lack of supporting infrastructure and services
- ☐ Current Sperrgebiet security regulations and access control

8. Education and Training

Sub-Sectors

- ☐ **Wilderness Training School**

- ☐ **Information Centres and Museums**
  - ☐ Desert museum
  - ☐ Heritage resources
  - ☐ Maritime museum
  - ☐ Mining activities (current and historical)

Areas of Opportunity

WILDERNESS TRAINING SCHOOL:

WHERE:	WHY:	WHEN:
Rosh Pinah or Lüderitz area	– Training of guides, trackers, park wardens – Training of policy-makers, park non-technical staff – Visits by school groups from neighbouring communities – Wilderness leadership courses for the public – Training of prospecting and mining employees	As soon as possible

INFORMATION CENTRES AND MUSEUMS:

WHAT:	WHERE:	WHY:	WHEN:
Desert Museum	Rosh Pinah	– General environmental awareness of visitors to the sub-region – Diversification of tourism attractions	?
Railway Museum	Aus		?
Maritime and Historical Museum (ship wrecks, mining history)	Lüderitz		?
Mine Museum	Oranjemund		Existing

Key Requirements and Input

- ☐ **Financial support / funding**
- ☐ **Museum design specialist**
- ☐ **Qualified tutors and support staff e.g. Wilderness Action Group of southern Africa)**
- ☐ **School / museum infrastructure**
- ☐ **Access road**
- ☐ **Transportation and equipment**
  - 4x4 vehicles, maps, GPS, radio, etc.
- ☐ **Water storage and transportation** (tanks / portable containers)
- ☐ **Waste management**
  - Collection and temporary storage
  - Disposal
- ☐ **Ablution amenities**
- ☐ **Power supply (solar / generator / gas)**
- ☐ **Supporting services** (Rosh Pinah)
  - Water supply
  - Fuel supply
  - Garages / workshops
  - Health care
  - Accomodation

Key Constraints

- ☐ Lack of sufficient funding
- ☐ Lack of supporting infrastructure and services
- ☐ Current Sperrgebiet security restrictions and access control

Preliminary Economic Analysis of Land Use Options

Introduction

This section presents a preliminary economic analysis[21] of the land use recommendations presented in preceding sections of this report. Economic models were developed, from published and other data, to derive the relative economic efficiencies for the primary competing land uses, namely tourism and mining in and around the Sperrgebiet. These two land uses will most likely determine important land allocation decisions in the Sperrgebiet.

Prospecting is seen as a temporary land use that should be managed to have minimal impact. Although conservation and research are seen as important land uses with potential to generate significant values, these values could not be determined in this preliminary analysis. Other proposed developments, such as irrigation development along the Orange River, the Kudu Gas Power Plant near Oranjemund, the Bolton Industrial Fish Farm, near Oranjemund, and the Wind Park near Lüderitz, have not been analysed. These will occupy only peripheral areas of land and, although they may compete for resources such as water, will tend not to affect land allocation in the study area. They have thus been excluded, or are discussed only briefly.

This study focuses on direct use values[22]. Although non-use or preservation values are particularly relevant to an internationally recognised biological hotspot such as the Sperrgebiet, these are only briefly discussed due to time and data limitations.

Approach and Methods

The approach to valuation, and the models used, are those developed and in use in the Economics Unit of the Directorate of Environmental Affairs (DEA) of MET. The approach embraces the concept of *total economic value* (Pearce and Turner, 1990). Total economic value, as applied to natural resources embraces several elements, such as:

- the DIRECT USE value of the resources, which is the net value associated with uses, such as mining, tourism, hunting, fishing, grazing, etc.

- the INDIRECT USE VALUE which has an indirect effect on direct use values. An example might be the value of clean groundwater, the depletion of which might affect grazing or tourism values.

21 Due to time and data limitations, the economic analysis was limited to a brief desk study focusing on specific direct use values.

22 Direct use values are values associated with the direct use of natural resources.

- The third category within total economic value is the NON-USE VALUES, which include option, bequest and existence values. These reflect the value of preservation of resources, either for future use (option value), for posterity (bequest value), or simply for their very existence (existence value).

Some characteristics of these values are depicted below (Barnes, 1996).

	Some characteristics of the types of economic value embraced within the concept of total economic value				
	Type of value				
	Use values		**Non-use values**		
	Direct	**Indirect**	**Option**	**Bequest**	**Existence**
Ease of measurement?	Good	Moderate	Poor	Poor	Very poor
Available data?	Some	Little	None	None	None
Realise as income?	Easy	Not easy	Difficult	Difficult	Difficult
Likely importance to:					
- Rural Namibians	Very high	High	Low	Low	Low
- All Namibians	High	High	Moderate	Moderate	Moderate
- Global society	Low	Moderate	High	High	High

The study focuses on direct use values – they are tangible, can be realised as income, and are important to an underdeveloped country like Namibia. For the same reasons, indirect use values are also important, but their measurement requires ecological data that are not available for the Sperrgebiet – there is no information on non-use values for the biological and cultural resources of the Sperrgebiet. Non-use values are also difficult and expensive to measure and very little research has been done on these in southern Africa.

The DEA uses spreadsheet budget and cost-benefit analysis models to determine the direct natural resource use activities. These are aimed at estimating both the *financial profitability* of these activities/enterprises, and their *economic efficiency*. The *financial* or private measures are made from the point of view of the individual investor or operator, and the *economic* or social measures are made from the perspective of Namibian society as a whole. The primary measure for economic value is *net value added* which is the annual contribution of the activity to the net national income (NNI). The models also generate estimates of the gross value added to national income (GNI), where GNI is roughly comparable with gross domestic product (GDP).

While the financial analysis simply reflects financial (or market) prices and transactions, the economic analysis uses shadow prices, or prices based on the opportunity cost to society. Shadow pricing criteria (Barnes, 1994) were used for this study. The most important of these were:

- a wage adjustment factor (0.35) for unskilled and semi-skilled labour wages;
- application of a premium (6%) reflecting excess demand for foreign exchange, which is applied to the price of all tradable items; and
- the elimination of domestic transfers not affecting income.

The use of shadow prices means that the national income measures derived are economic *efficiency* measures and not simply statistical ones as recorded in the national accounts.

The models have a static component depicting the activity at full production, and a dynamic component depicting the investment over five and ten years. The static financial models involve subtraction of variable and fixed financial costs (which include interest, amortisation, government fees, royalties and land rentals) from the financial turnover to derive a net income (before income tax). The static economic models involve subtraction of intermediate economic costs from gross output to derive gross value added, and then subtraction of depreciation to derive net value added. They take account of foreign inflows and outflows, exclude domestic interest, taxes and subsidies, and also exclude land costs and central government expenditures. The dynamic financial models are at constant prices, exclude interest and depreciation and include asset residual values to measure internal rate of return and net present value. Economic dynamic models include foreign inflows and outflows and measure the economic internal rate of return and net present values, before consideration of land costs and public expenditures.

With appropriate modification (taking into account the specific products and demand) financial and economic models already developed in the DEA were adapted to estimate tourism values for the Sperrgebiet. Of relevance here, are models already developed for wildlife-viewing lodges, tented camps, community campsites, community tourism services, craft marketing and mobile tour operators in Namibia. Other relevant models used were those for livestock ranching (including small-stock production in southern Namibia) and game ranching for production of trophies and meat, as well as non-consumptive tourism such as wildlife viewing. These models are based on empirical physical and financial data gathered between 1994 and 1999 [23]. It must be noted that the economic *value* of tourism activities and not their *impact* was measured. The latter would involve a full tracing of the multiplier and linkage effects associated with tourism. The economic tools are not available for this at present.

Specific models were developed in an attempt to measure the contribution of mining operations to national income. However, stemming from the traditional large-scale and monopolistic nature of most mining operations and/or the unavailability of this data for public use for confidentiality reasons, there is a lack of empirical operational costs data for individual mines. For this reason, the estimates for metals mining activities are based on a generalised model and the estimates for diamond mining are based on the metals mining model. Given the structure of the models and the gross output figures involved, this is not an unreasonable assumption. The gross output values associated with mining *are* available and this made it possible to provide a fairly realistic range of estimates for the direct use values. Further details regarding the models used are provided in Appendix D.

Preliminary Results

Indirect Use and Non-use Values

No data were found to enable valuation of indirect use values in the study area. Groundwater in the Koichab is being used to supply the town of Lüderitz and maintain the industrial activities such as fish processing. This resource is said to be depleting and the cost of this depletion may be defined as an indirect use value. There are no physical data on this depletion with which to attempt a valuation.

[23] Such analyses are described by Ashley (1995), Ashley and Garland (1994), and Barnes and de Jager (1996).

There is an urgent need for investigation into the full economic costs and benefits associated with sustainable provision of water for the main growth nodes and land use activities in and around the Sperrgebiet. For example, the option of desalination of sea water in the case of Lüderitz needs investigation. The economic values of resources in the area may be affected by water and air pollution associated with the major future development activities. This also requires rigorous analysis in physical and economic terms (including all values), to ensure that national welfare is enhanced and not jeopardised.

The natural resources in the Sperrgebiet have high significance since they fall within an internationally recognised hotspot for biological conservation. This suggests that there are likely to be non-use values associated with these. Similarly, there are historical and archaeological assets in the study area that are likely to attract non-use values, but there is no information on the magnitude of these values.

As illustrated in the table above, non-use (i.e., option, bequest, and existence) values associated with the Sperrgebiet are likely to be low or moderately high among Namibians. This would be because most Namibians are concerned with immediate and pressing development needs, notably the creation of jobs and income. People in developed nations, however, have concerns about international conservation issues, and in aggregate, exhibit willingness to pay for them. The flow of funds through conservation NGO's and aid agencies aimed at conserving natural assets can be categorised as non-use values.

Information on the non-use values for the Sperrgebiet or other wild areas in Namibia is generally limited but some research work on non-use values among users (tourists) has been done in South Africa. Oellermann *et al* (1994) used a bidding technique to survey the willingness to pay to prevent flooding of the Wakkerstroom wetland (a small wetland in Mpumalanga Province, South Africa) among 50 members of the local Wakkerstroom Natural Heritage Association. Median willingness to pay for option values was between N$17 and N$20 per month. For existence and bequest the median willingness to pay was between N$15 and N$18 per month.

Holland (1993) conducted a detailed survey of 246 visitors to four protected areas (recreation areas and game reserves) in KwaZulu-Natal Province, South Africa, using a bidding technique to elicit their non-use values for the sites. Results for the Royal Natal National Park indicated that visitors were willing to pay between N$12 and N$15 per month to a fund for the option, bequest, and existence values of the park. The total annual non-use value perceived by visitors was calculated to be N$389,000, amounting to N$43 per hectare of park.

The closest indication of non-use values for natural assets in Namibia is in the result of a 1996 general wildlife-based tourism demand survey (Barnes *et al*, 1999) where 750 tourists from the general tourist population were sampled. Asked to name the main attraction(s) that had induced them to take their trip, tourists most frequently mentioned 'unique unspoiled nature/landscape'. This suggests that sentiments for preservation of unspoiled wild areas are important. In the same survey tourists were asked if they would be willing to pay towards a special *conservation trust fund* that would be used directly in 'conserving and protecting wildlife in Namibia', and if so how much. 70% of respondents said 'yes'. The willingness to pay for the *whole* sample of 750 tourists (including those who would pay nothing) was calculated to be approximately N$100 per tourist per annum. The aggregate willingness to pay among wildlife based tourists on Namibia was approximately N$29 million.

Although this evidence applies only to users (tourists) and to environments that are more or less different from those in the Sperrgebiet, it strongly suggests that option, bequest and existence values, for natural (and possibly cultural) assets in the Sperrgebiet, do exist. The importance of these values to Namibia depends on whether they can be captured in the form of income. Mechanisms, such as donor-funded conservation investment projects and conservation funds, are needed to ensure capture of these values. The primary land use, that will enable preservation of these values, is conservation and research. However, with appropriate planning and management, they can also be preserved under land uses such as tourism and prospecting.

Direct Use Values

Agriculture

The commercial farmland on the eastern border of the Sperrgebiet is either unused or used for extensive small stock (sheep) ranching. Modification of the financial and economic model of small stock ranching in southern Namibia, for application in this extreme environment, provides an insight into the values involved. Given the extremely low and erratic carrying capacity of rangeland in these areas, it is likely that financial returns to these investments are extremely low to negative. This would explain why some of this land is unused. The contribution of livestock ranching in these areas to national income is also likely to be extremely low. There is a tendency for landholders to invest in tourism ventures in which both the financial and economic returns are higher. As confirmed by the economic models (Barnes and de Jager, 1999), livestock ranching is considered as having no economically efficient role to play in the Sperrgebiet.

Irrigation development for crop production is physically possible on alluvial soils found in a few places along the lower Orange River. This type of development, creating jobs and significant income per unit area, tends to attract financial subsidies from central government. However, the remote location from markets and input sources tends to suggest that large-scale commercial irrigation development, even with high value crops, would be economically inefficient – prior to consideration of the value of any detrimental environmental effects. Irrigation agriculture is peripheral to the main land allocation issues within the Sperrgebiet, and is therefore not discussed in more detail.

Tourism

Tourism in Namibia

Article 95:L of the Namibian Constitution states:

'*The state shall actively promote and maintain the welfare of the people by adopting policies aimed at maintenance of ecosystems, essential development processes and biological diversity of Namibia and utilisation of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future.'*

Although it is often purported to be, tourism is not yet a dominant factor in the Namibian economy. However, it harbours great potential to capture the direct and indirect values of Namibia's lands and hence to spur domestic, regional and local economic development. Innovative and well-structured tourism management will be necessary to realise this potential. The current and past *ad hoc* nature of development in this sector will not serve well as a template for the future, particularly when considering the Sperrgebiet's tourism potential.

Attempts to model and forecast tourism in Namibia, southern Africa and internationally, are consistently hampered by the unpredictable nature of tourism. Indeed future growth predictions in stable regions with reliable and complete data often prove unreliable. Furthermore, the fugacious tourism market in southern Africa, where tourism in one area can depend on political events occurring elsewhere in the region, and even internationally, implies that economic modelling cannot provide more than baseline data.

The need for local economic development and local ownership of the 'product' is important. The towns of Aus, Lüderitz and Rosh Pinah are set to grow in size and economic importance in the next ten years, as mining attracts new ancillary and supply businesses to the towns and the infrastructure is upgraded. Tourism will also be part of this growth as an increasing number of visitors use and contribute to (indirectly) local infrastructure, a sustainable diversity of land uses, jobs, increased product ranges and beneficial ancillary services (such as shops, catering, entertainment, medical, telecommunications, repairs).

Current Tourism in the Western Karas Region

Some of the characteristics of tourism in the western Karas region, as derived from official data from the Policy, Planning and Management Information Unit (PPMIU), Directorate of Tourism, MET, and calculations based on models developed (see Appendix D), are tabulated below:

Current tourism profile for the western Karas region (Sperrgebiet)	Aus	Lüderitz	Rosh Pinah
Number of tourists /annum	3,168	30,000	0
Average length of stay (nights)	1.25	1.92	0
Number of visitor days /annum	4,000	90,000	0
Amount of tourism industry (N$ gross expenditure)	N$ 0.82m	N$ 20m	N$ 0
Contribution of Sperrgebiet to gross expenditure (N$)	N$ 0.41m	N$ 11.17m	N$ 0
Net value added by the Sperrgebiet (N$)	N$ 103, 606	N$ 3, 592, 050	N$ 0

The current tourism profile identifies Lüderitz as the destination for tourists to this area, and consequently the core economic activities servicing tourism are centred here. Aus benefits from being a stopover on the route to Lüderitz, while Rosh Pinah has, until recently, not benefited from tourism at all.

A significant proportion of current tourism within the Sperrgebiet is focused on historical attractions relating to Namibia's early German colonial past, attracting a significant proportion of German tourists. Other tourist attractions include the desert and coastal scenery. South African tourists make up a large proportion of the tourism population. Current tourism is based on day trips taken from Lüderitz.

Potential Tourism Activities in Western Karas Region

To investigate the economic importance and current and future dynamics of tourism in more detail, models were developed for four tourism activities in the western Karas region. They are based on data from similar operations run elsewhere in Namibia and the southern African region, and are used to estimate current direct benefits, as well as future benefits resulting from the future possible growth of tourism.

The four models developed are:

- *Sperrgebiet Land Tours*: guided day tours into the Sperrgebiet in operator's own vehicles. Based in each of the three development nodes, these would be operated by local (Namibian) tourism entrepreneurs.

- *Sperrgebiet Boat Tours*: guided day tours along the Sperrgebiet coastline in operator's own craft. Based in Lüderitz, these would be operated by local (Namibian) tourism entrepreneurs.

- *Campsite*: located on commercial land on the Sperrgebiet borders amid dramatic scenery offering some activities on its land plus opportunities to venture into the Sperrgebiet.

- *Lodge and Campsites*: middle-range lodge located on commercial land on the Sperrgebiet borders amid dramatic scenery offering many activities on its land plus opportunities to venture into the Sperrgebiet.

These activities are aimed at capturing the diverse nature of demand for tourism in the study area (historic, scenic, geological, nature, wildlife, archaeological, adventure) and the diverse nature of the tourism attributes. Details of the net values added and employment levels generated per enterprise for each of these activities are tabulated below:

Economic results from base case tourism models (per enterprise):	Net value added (NVA) per annum (N$)	Employment (No.)
Sperrgebiet land tours	463, 313	12
Sperrgebiet boat tours	67, 200	5
Campsite	93,696	3
Lodge and campsites	89,799	23

The dynamics and results from these models are combined with available tourism data to model the potential future scenarios for tourism in these three development nodes.

Lüderitz

Using simple extrapolation from the economic models, it is estimated that the annual tourist numbers to Lüderitz will be 30,000, each with an average stay of approximately two nights, and a total of 90,000 tourist days. This generates between N$17 and N$25 million of economic benefits to the town, and directly supports between 187–272 jobs in the town's tourism economy, and a further 468–681 jobs in the wider Namibian economy (chiefly in support services supplying the tourism industry).

Current tourism infrastructure profiles, typical of Lüderitz and Swakopmund, suggest an immature tourism accommodation market. This is evident when one examines the effect of the opening of the Nest Hotel in 1999. Where capacity increased, there was no obvious substitution effect from the town's other hotels. Indeed, there is a stated need by tourists for more 'family oriented' accommodation. Details on the current accommodation profile in Lüderitz are shown below:

Current tourist accommodation profile in Lüderitz	Number of establishments	Approx. price (N$)[24]
Hotels	6	225
Bed and breakfast establishments	4	125
Self-catering accommodation	2	50

Evidence and data from Namibia's other coastal resort, Swakopmund, were used with 'benefits transfer' to estimate the likely tourism values for Lüderitz under different scenarios. The data from Swakopmund, a more centrally placed and more intensively utilised destination, was modified to reflect the more remote and slightly more specialised nature of Lüderitz. The results are shown in the table below:

Level of economic development	Net value added for Lüderitz from tourism over 2000-2020 under different scenarios (N$):			
	YEAR			
	2000	2005	2010	2020
Year 2000	3,592,050			
Nothing[25]		4,394,066	4,394,066	4,394,066
Low		4,924,579	5,387,892	5,851,205
Medium		5,455,092	5,985,605	6,516,118
High		5,918,405	7,442,744	7,442,744

The first scenario (denoted 'nothing') estimates what would happen in Lüderitz if there were no other new developments, mining or otherwise, in the Sperrgebiet[26]. It serves as the baseline by reflecting the maturation of the tourism market in Lüderitz and the utilisation of slack capacity[27].

There is likely potential for up to five Sperrgebiet land tours and three Sperrgebiet boat tours operating from Lüderitz. Currently, the net value added for Lüderitz is approximately N$3.60 million. The scenarios denoted as 'low', 'medium' and 'high' reflect values for Lüderitz resulting from differing rates of tourism development (including the taking up of slack capacity as well as development stimulated by new mining and other developments in the Sperrgebiet) over the next 20 years. The results indicate that net value added due to first round spending by tourists in Lüderitz could increase by up to 70% over a twenty-year period, 2000 to 2020. [28]

24 Approximate average price net of meals and activities.

25 'Nothing' refers to the maturation of Lüderitz's tourism market, and serves as baseline data indicating what will happen if no further development of the Sperrgebiet occurs.

26 Discussed in more detail in Appendix D.

27 Tourism development in most locations is a result of booms, dips and plateaux over time. The concept of 'slack capacity' refers to the observed and expected changes in Lüderitz currently and in the recent past that are not captured by the year 2000 figures. Indeed, this model predicts increases, over 20 years, of between 12.79% and 35.02% of gross tourist expenditure in Lüderitz to between N$ 19m and N$ 35.75m owing to this slack capacity.

28 The added but indirect benefits to the town such as other tourist activities, more accommodation, shops, etc, due to further rounds of spending and backward and forward linkages are not included in the estimations (i.e., the value but not the full *impact* of tourism is measured).

Aus and the Eastern Sperrgebiet Border

Using the tourism data, the financial and economic models, and simple extrapolation techniques, it can be estimated that the annual tourist numbers visiting Aus will be 3,168, with an average stay of 1.25 nights, and a total of 4,000 tourist days. This generates between N$0.65 and N$1 million in economic benefits for the town and surrounding area, is responsible for approximately seven direct jobs in the tourism economy, and might support a further 15 jobs in the Namibian economy, chiefly in support and supply services[29].

Aus currently serves the coastal town of Lüderitz, and although it is in a scenically attractive spot, it is undeveloped. Any potential is dependent on the further development of Lüderitz, pulling in greater volumes of tourists. Currently 10.5% of visitors to Lüderitz spend one to two nights in the Aus area. There is potential for up to three Sperrgebiet land tours, three lodges/campsites and three campsites to operate in Aus and the north-eastern Sperrgebiet borders.

The current net value added by tourism for Aus is estimated at approximately N$0.023 million. The table below presents four estimates of net value added accruing to Aus from tourism until the year 2020. 'Low', 'medium' and 'high' estimates reflect different rates of development in tourism over a twenty-year period, 2000 to 2020.

Level of economic development	**Net value added for Aus from tourism over 2000-2020 under different scenarios (N$):**			
	YEAR			
	2000	**2005**	**2010**	**2020**
Year 2000	23,717			
Nothing		183,495	183,495	183,495
Low		183,495	273,294	366,990
Medium		752,698	846,394	1,321,901
High		1,138,406	1,707,609	1,707,609

The scenario denoted as 'nothing' refers to the forecast net value added where the local Aus market is mature but with no new mineral and other development in the Sperrgebiet.

The data suggests that there is potential to increase the tourism net value added by between 800 and 9000% over the next 20 years.

Rosh Pinah

There is almost no tourism in the traditional sense in Rosh Pinah. Hotel accommodation here serves consultants and business visitors to the mine. The current net value added from the Sperrgebiet for Rosh Pinah is assumed to be negligible. There is, however, potential for up to four Sperrgebiet land tours and four accommodation establishments in Rosh Pinah.

[29] Details on estimation methods and extrapolations used are discussed in Appendix **D**.

Level of economic development	Net value added for Rosh Pinah from tourism over 2000-2020 Under different scenarios (N$):			
	YEAR			
	2000	2005	2010	2020
Year 2000	0			
Nothing		0	0	0
Low		464,346	558,042	651,738
Medium		558,042	928,693	1,393,039
High		928,693	1,393,039	1,857,386

The above-mentioned data gives four estimates of net value added accruing to Rosh Pinah from tourism until the year 2020. 'Low', 'medium' and 'high' estimates depict differing rates of tourism development over this period. Once again, 'nothing' refers to the forecast net value added if the tourism market is taken to maturity in Rosh Pinah, with no new Sperrgebiet developments, mining or otherwise. In this latter case, it is considered that there is almost no potential for expansion, and the value added is assumed to be zero.

However, there is *potential* to increase the tourism net value added in Rosh Pinah from nothing to between N$ 0.65 million to N$ 1.86 million over the next 20 years.

Aggregated Sperrgebiet Values for Tourism

Totals of the projections for each of the three development nodes are tabulated below. It is forecasted that the net value added for the Sperrgebiet could be increased by between 24 to 215% over the next 20 years, given the developments detailed previously.

Level of economic development	Total net value added from tourism in the Sperrgebiet over 2000-2020 under different scenarios (N$):			
	YEAR			
	2000	2005	2010	2020
Year 2000	3,615,767			
Nothing		4,577,561	4,577,561	4,577,561
Low		5,572,421	6,219,229	6,869,934
Medium		6,765,833	7,760,692	9,231,059
High		7,985,504	10,543,393	11,007,739

Mining

Metals Mining

A cost benefit enterprise model was developed for a typical mine in the vicinity of Rosh Pinah. Information and data were collected from various sources[30], and the model was designed to reflect a typical zinc mine in this area of the Sperrgebiet[31].

30 Development Planning and Research (1998a, 1998b), Lange and Motinga (1997), Walmsley Environmental Consultants (1998).

31 See Appendix **D** for the summary of the financial and economic model of a typical zinc mine in this area.

Assumptions for, and structure of, the metals mine model are essentially the same as those for the tourism enterprises. The chief aim was to develop a model which could reflect the relative worth to Namibia of the proposed mine and hence the potential returns from newly developing mining operations in the light of current prospecting.

The model shows a very high *economic* rate of return and net value added indicating the very positive returns for Namibia during the lifetime of this mine, as well as its economic efficiency. When compared with alternative land uses, the mining model has no competition from an economic standpoint. However, mining operations, being based on exhaustible resources, are not sustainable in the long term. The modelling results are summarised below:

Economic results in the model of a typical Sperrgebiet metals mine:	**Rate (%) or Amount (N$)**
Net value added (per annum)[32]	N$118,944,802
Net value added as a proportion of investment[33]	10. 9 %
Economic rate of return (@ 10 years)	160. 72 %
Financial rate of return (@ 10 years)	12. 18 %
Economic cost of each job created	N$4, 133, 640
Total permanent infrastructure[34]	N$280, 200, 000
Permanent Namibian jobs created	329
Mine life (+ construction)	12 (+2.5) years

The net value added of the Sperrgebiet for metals mining for the three development nodes and for the Sperrgebiet as a whole, is tabulated below:

Anticipated net value added of the Sperrgebiet for metals mining for each of the development nodes over 2000-2020 under different scenarios (N$)

Lüderitz	**2000**	**2005**	**2010**	**2020**
– Year 2000	0			
– One mine		15,819,659	15,819,659	0
– Two mines		15,819,659	27,714,139	11,894,480
– Three mines		15,819,659	27,714,139	27,714,139
Aus	**2000**	**2005**	**2010**	**2020**
– Year 2000	0			
– One mine		0	0	0
– Two mines		0	0	0
– Three mines		0	0	0
Rosh Pinah	**2000**	**2005**	**2010**	**2020**
– Year 2000	39,251,785			
– One mine		158,196,587	158,196,587	0
– Two mines		158,196,587	277,141,389	118,944,802
– Three mines		158,196,587	277,141,389	277,141,389

32 Gross Value Added excluding depreciation per annum.

33 Net Valued Added divided by Total Economic Capital of N$ 1, 951, 078, 168.

34 Fixed Capital with a lifetime in excess of 30 years.

Anticipated net value added of the Sperrgebiet for metals mining for each of the development nodes over 2000-2020 under different scenarios (N$)

Sperrgebiet	2000	2005	2010	2020
– Year 2000	39,251,785			
– One mine		174,016,245	174,016,245	0
– Two mines		174,016,245	304,855,528	130,839,282
– Three mines		174,016,245	304,855,528	304,855,528

Diamond Mining

As stated previously, there is insufficient public information with which to develop a diamond mining model. Instead, net value added proportions determined with the metal mining models were combined with the diamond industry's gross output values to estimate the net value added in diamond production for Namibia as a whole. This figure is N$10,408 million. The value is extremely high in relation to those of the other land uses.

Economic Returns from Mining in Conjunction with Tourism

The tourism scenarios for Oranjemund contained in the literature were designed before the recent introduction of the Diamond Act. The Act makes any economically meaningful tourism in or based from the town unfeasible.

These scenarios do promise potential for sustainable economic benefits from tourism once mining activities wind down around 2020, although given the strength of prospecting and technological advances, it would be premature to take this date as a reliable benchmark.

Rosh Pinah with differing levels of mining in conjunction with tourism

The anticipated net value added estimated for three different scenarios of metals mining in conjunction with tourism are tabulated below:

Rosh Pinah: Combined mining and tourism value projections with ONE MINE only

	2005		2010		2020	
Tourism Level	Net value added (N$)	Employ-ment (No.)	Net value added (N$)	Employ-ment (No.)	Net value added (N$)	Employ-ment (No.)
Low	61,319,068	334	61,412,764	335	61,506,460	336
Medium	61,412,764	335	61,783,415	338	62,247,761	343
High	61,783,415	338	62,247,761	343	62,712,108	348

With the afore-mentioned scenario, the average percentage of net value added contributed by tourism varies from 0.8% to 3% of total net value added from the Sperrgebiet for the town.

Rosh Pinah: Combined mining and tourism value projections with TWO mines

	2005		2010		2020	
Tourism Level	**Net value added (N$)**	**Employment (No.)**	**Net value added (N$)**	**Employment (No.)**	**Net value added (N$)**	**Employment (No.)**
Low	122,173,790	663	122,267,486	664	122,361,182	665
Medium	122,267,486	664	122,638,137	668	123,102,483	673
High	122,638,137	668	123,102,483	673	123,566,830	678

The average percentage of net value added contributed by tourism varies from 0.4% to 1.5% of total net value added from the Sperrgebiet for the town in the above-mentioned scenario.

With the following scenario (tourism plus three new mines), the average percentage of net value added contributed by tourism varies from 0.25% to 1% of total net value added from the Sperrgebiet for the town.

Rosh Pinah: Combined mining and tourism value projections with THREE mines

	2005		2010		2020	
Tourism Level	**Net Value added (N$)**	**Employ-ment (No.)**	**Net value added (N$)**	**Employ-ment (No.)**	**Net value added (N$)**	**Employ-ment (No.)**
Low	183,028,512	992	183,122,208	993	183,215,904	994
Medium	183,122,208	993	183,492,859	997	183,957,205	1,002
High	183,492,859	997	183,957,205	1,002	184,421,552	1,007

The three scenarios illustrate the predominance of metals mining values among the natural resource values that can be captured for Rosh Pinah between 2000 and 2020. Although tourism growth in the town will be significant, it cannot compete economically with metals mining as a land use in the short to medium term.

Lüderitz with differing levels of mining in conjunction with tourism

The estimated natural resource values (in terms of net value added), which could be captured for Lüderitz from both tourism and mining in 2020, are tabulated below:

Anticipated economic values for Lüderitz from tourism and mining in 2020	**Tourism net value added (N$)**	**Mining net value added (N$)**
Lower bound value	4,394,066	3,925,178
Upper bound value	7,442,744	27,714,139

The values reflect those from the Sperrgebiet that would be captured by Lüderitz in its dominance as the regional port and main tourist centre. Lower and upper estimates are given to aid comparison. The anticipated economic gain from tourism growth in Lüderitz will be high over the next 20 years. It will compliment those anticipated economic gains for Lüderitz, attributable to mining in the Sperrgebiet.

Conclusion

As an exercise to assess the economic implications of the land use options in the Sperrgebiet, this study is incomplete. The indirect use values associated with the area's resources remain undetermined. They have not been measured and to do so would require a significant investment. There is strong evidence that they do exist, and one likely component of them is associated with the problem of groundwater depletion. The non-use values of the resources in the Sperrgebiet are also undetermined, and again, a very large investment would be needed to do so. There is indirect evidence that these could be significant. This evidence centres around the option, bequest and existence values of natural biological diversity in the area, linked to it's moderately high-profile international status as a hotspot. These values are also likely to be associated with historical and archaeological attributes in the area.

The non-use values are of interest to Namibia in that, with appropriate mechanisms, they can be captured as national income. This can be achieved through solicitation of international aid or donations for preservation of the area's biodiversity. The actual values involved are likely to increase with time as the world's biodiversity continues to be depleted. There is a high likelihood that these values could contribute significantly to national income in the future. It is thus vital for Namibia to ensure that they are preserved in the land allocation process. They will be preserved on land allocated to conservation and research, and *can* be preserved on land used for prospecting and tourism if these areas are managed carefully.

The availability of data and analytical results has enabled the formulation of direct economic use values for the primary resources affecting land use allocation in the area. The table below illustrates the anticipated direct net value added to the national income from various natural resource uses for the Sperrgebiet at 2020, as derived from the results presented above. Lower and upper bound estimates are given, showing the range in estimation.

Anticipated total annual net value added from natural resources uses in the Sperrgebiet in 2020	**Net value added (N$)**	
	Lower bound	**Upper bound**
Agriculture	0	0
Tourism	4,394,066	7,442,744
Metals mining	3,925,178	27,714,139
Diamond mining	10,408,105,890	20,816,211,780

The sums involved are considerable, and clearly dominated by the diamond mining values. Agriculture is considered economically unfeasible or, in the case of irrigation development, which *may* be feasible, it is considered peripheral. The sectors with comparative advantage, in terms of direct use value, are tourism and mining.

Mining is likely to be associated with some negative effects on the environment which will affect other values. Much research remains to be done before quantification of indirect use values is sufficiently scientifically robust, and their impact on policy and land use decisions remains limited. Yet, adopting crude benchmarking and using the concept of irreversibility, we conclude that the negative effects and values associated with mining are likely to be somewhat localised. With proper planning this should help minimise the long-term risks to biodiversity in the study area. All upstream and downstream effects of industry (groundwater depletion, water and air pollution, and other effects) should be

examined in a full economic development analysis, as part of an EA, but current data levels and tools in Namibia preclude this. Ongoing research into all these values is recommended.

It can be said that the highly significant economic values generated by mining will make mining a primary natural resource use in the Sperrgebiet area well into the future. Tourism direct use values are also significant and these have long term sustainability, while those of mining do not. Tourism contributes directly to incomes and should also be a primary natural resource use in the area. Conservation as a land use has non-use value and is *likely* to generate significant income in the future. Thus, on economic grounds it should also be a primary land use. The mining activities are and will be restricted spatially, and there is thus good potential for the rational integration of mining, tourism development, and conservation.

Sensible use of exhaustible resources, such as minerals, involves the capture of economic rents and their reinvestment on sustainable activities. In this way, and with the appropriate resource use trajectory, the short-term benefits of mining should be able to contribute maximally to sustainable development. The planning of mining activities should ensure that the natural capital which forms the base for tourism use values and conservation non-use values in the Sperrgebiet is preserved and developed. The non-use values associated with the natural environment in the Sperrgebiet should also be conserved. The challenge is to ensure that mining, tourism and conservation in the Sperrgebiet are integrated in a way which maximises national welfare.

Administrative Framework

The President of the Republic of Namibia, Dr Sam Nujoma, recently stated that "… we must ensure that the natural beauty of our country is maintained, that our National Parks and Game Reserves are looked after well, and that our wildlife is properly managed…" (Namibia Environment Volume 1 (1996) p5).

This proposed management structure for the Sperrgebiet is on the macro-level. For the purposes of this recommendation, consideration is only given to the establishment of a managerial structure in terms of the establishment of the Sperrgebiet protected area.

Re-proclamation

The Sperrgebiet is currently un-proclaimed government land with Namdeb and other mining companies holding substantial mineral and prospecting licences over the area. Before any future development can occur, the Sperrgebiet will have to be re-proclaimed. The proposal is that the area be proclaimed as a National Park falling under the Ministry of Environment and Tourism. The MET will then manage the environmental affairs of this area. A second option is to expand the boundaries of the existing Namib Naukluft Park (NNP) down to the Orange River. This would require a new name for the whole park e.g. Namib Desert National Park, or the Sperrgebiet could retain its evocative name as a section of an enlarged Namib-Naukluft Park. Currently the NNP is the third largest in Africa after the Selous Park and the Central Kalahari Park. Should the boundaries of the Namib Naukluft Park be extended, Namibia will be able to boast the biggest park in Africa.

The extension of the boundaries will not mean that there is a change in the current Management Proposal. The inclusion of the Sperrgebiet in the NNP will still be subject to the unique situation within the Sperrgebiet and cognisance should be taken of this e.g. retaining the name Sperrgebiet for this section of the NNP. Apart from the ecological sensitivity of the area, there is a further uniqueness to the Sperrgebiet, which lies in the fact that there are a number of key role players, such as:

- Ministry of Environment and Tourism,
- Namdeb,
- Ministry of Mines and Energy,
- Chamber of Mines,
- Governor of the Karas Region,
- The CEO's or their duly authorised representatives of the three Local Authorities (Lüderitz, Oranjemund and Rosh Pinah),
- Ministry of Fisheries and Marine Resources,
- Ministry of Lands, Resettlement and Rehabilitation,
- STF (Southern Tourist Forum),
- The adjacent farming community, possibly in the form of a conservancy,
- Various NGOs representing interested parties e.g. NNF and Wildlife Society, and
- Aid organisations e.g. DANCED who funded this LUP.

Their specific relationships with one another will be governed by legislation (e.g. the new Environmental Management Act). The formal interaction of these parties will be through a Management Advisory Committee.

Management Advisory Committee

It is recommended that a Management Advisory Committee be set up with the following members:

- Governor of the Karas Region:
  - To chair the Advisory committee. The Sperrgebiet is situated in the Karas region, which would be the main beneficiary of any economic development. It is important that the Sperrgebiet is seen to be to the benefit for all.

- The Ministry of Environment and Tourism: Directorates of Resource Management, Environmental Affairs and Tourism:
  - Will form the secretariat of the committee.

- Namdeb:
  - Due to the number of mining licences and the security measures, which Namdeb currently implements, it is crucial that they play a key role on the committee.

- Ministry of Mines and Energy:
  - Because of mining rights and mining legislation with regards to rehabilitation and mining licences, current and future.

- Chamber of Mines:
  - To represent other mining and prospecting companies active inside the Sperrgebiet (current Skorpion and future).

- Ministry of Fisheries and Marine Resources:
  - Representing the crayfish and seal culling concessions along the Sperrgebiet coast, as well as the offshore islands and intertidal zone.

- National Botanical Research Institute, National Museum:
  - Representing scientific research interests.

- Ministry of Lands, Resettlement and Rehabilitation:
  - The land is currently under the jurisdiction of this Ministry.

- STF (Southern Tourist Forum):
  - This organisation represents the private sector in terms of tourism in the south of Namibia. It is a well-established tourist orientated organisation based in Keetmanshoop, which would be a role player once tourist concessions are established. It is possible that an existing member would gain a concession, but if not, the future concession holder would surely become a member of this organisation. The establishment of a park will also have an effect on current member's tourist establishments, and not only could they benefit, but also provide accommodation around the park because no permanent structures will be built in the park.

- The adjacent community:
  - It is possible for this group to form a conservancy, subject to the regulations governing this process. There is currently no such conservancy bordering the Sperrgebiet. Should this group form a conservancy, they could play a big, unified role in terms of the creation of a buffer adjacent to the park. If there is not such a need on their behalf, then they could be represented by the STF on the advisory committee.

- The CEO's or their duly authorised representatives of the three Local Authorities (Lüderitz, Oranjemund and Rosh Pinah) and the village of Aus.
  - Although these local authorities would not obtain areas larger than their existing municipal boundaries, they could benefit from the Sperrgebiet becoming a park. These towns and villages would become gateways to the park.

  - Oranjemund could become a prime tourist destination once mining activity diminishes. Should Namdeb vacate Oranjemund at some stage in future, Oranjemund could become a ghost town unless it forms part of a bigger tourist orientated project. Oranjemund on the banks of the Orange River would be able to offer more to tourists than being purely an end destination if incorporated into the activities available in the Sperrgebiet.

  - The MET office in Lüderitz would be the office concerned with the direct day to day management of the area. Should Lüderitz become a gateway, it makes the idea of the Waterfront more feasible. Lüderitz will form one of the natural starting points for entering the park, thus benefiting from the increased tourism flow into the area.

  - The mining company town of Rosh Pinah is currently in the process of being proclaimed as a town, to reflect the diversification of its economy. From merely being the settlement associated with the lead-zinc mine, the town has become the focus of intensified prospecting activity and will also provide the services and accommodation for the Skorpion Zinc Mine. Furthermore, in view of its position in the Huns-Ai-Ais Park and its proximity to some of the most scenically interesting parts of the Sperrgebiet, Rosh Pinah will also benefit from increased tourism.

  - The village of Aus provides the gateway to the north-east corner of the Sperrgebiet and the South-eastern part of the NNP. Although growth may not be as rapid as at Rosh Pinah, the village will experience considerable growth.

Actual proposed management structure and the role of the Advisory Committee

The day to day management of the park will be the responsibility of the MET. They will follow the new legislation which will govern MET's management style. They already have an office in Lüderitz, which will form the centre of their activities. Once the actual areas and activities have been established, a clearer management structure (organogram and job descriptions) can be put in place following the MET's existing management system and structure. Concessionaires (tourism, mining and fishing) and other parties such as geologists could become honorary 'game rangers' thus complimenting MET employees. This will be helpful because of the vastness of the area.

The actual management structure of the MET and tourism concessionaires should be analysed and decided on after agreement between all parties has been achieved and government has agreed to the park in principle.

The role of the advisory committee is two fold. In the first instance, the role players will not act purely as an advisory committee, but rather as a negotiation forum where all parties lay down the parameters with regard to the park during Phase 2 of the study. One could consider making use of a 'go between' in the initial stages to make sure that common ground is achieved before getting all parties around a table for discussions/negotiations. Attempting to go ahead with the establishment of the park is futile, unless consensus is achieved amongst all role players. Legislation affecting all the parties will come into play at this stage. The Namibian Parks and Wildlife Act is in the process of finalisation. This act will enable the MET to divide the park into different areas of ecological sensitivity allowing different activities to take place in different areas. All role players will thus be subject to this new act with regards to their operational limitations in the park. Environmental assessments and management plans will be required for all activities listed in the forthcoming Environmental Management Act.

Once the park has been gazetted, the key role of the advisory committee will come into play. The advisory committee will not form part of the active management process within the park. They would give strategic advice on integrated management and sustainable development of the park. They will advise on any land use changes and issues to be addressed in environmental assessment studies in the park. All the parties to the advisory committee will, in some way, be associated with the park, and it is therefore imperative that they have some insight and say on the long-term management strategies for the park.

The Management Advisory Committee will also be responsible for advising on the awarding of tourism concessions in the Sperrgebiet, including aspects such as:

- tender system;
- pricing policies;
- length of concession periods;
- monitoring and review of environmental performance by park management;
- putting up 'Rehabilitation Bonds' or 'Trust Funds' on the award of the concession for use by MET to repair any damage caused;
- contributions of a percentage of earnings to the park;
- incentives for good management;
- qualifications of tour guides e.g. they must pass the Sperrgebiet Training Module; and
- establishment of a points / penalties system.

The committee will act as a sounding board for the MET. Should new land use ideas be generated, or new tourist attractions be considered by MET, these should be considered by the Committee. The Committee should preferably meet every three months or at a frequency dictated by specific needs. In the beginning it would be advisable that the Committee meet more frequently to finalise critical issues.

It is imperative that the Management Advisory Committee be accountable to the Minister of Environment and Tourism. This will ensure that time frames are kept and deadlines are adhered to, and that all parties keep to mutually agreed rules and regulations with regards to their interaction.

A further role of the committee would be to mediate/arbitrate disputes that might arise amongst its members. This will avoid lengthy court cases and unnecessary delays with regard to the implementation of decisions.

Zoning

The rights of the various role players and stakeholders have been taken into account in the zoning proposals described earlier in this Land Use Plan (Map 10, page 67). All current mining licence areas have been zoned as category 6 (Managed Resource Protected Area) in terms of the IUCN Park Management Categories. Some of the prospecting blocks fall in Zone 2 which will allow controlled mechanised access, but some blocks fall within Zone 1b (Wilderness Areas). Special areas will have to be demarcated within this zone to allow for controlled mechanised access for the duration of prospecting. Time limits will have to be imposed and the areas should be fully rehabilitated after prospecting ceases.

Future Access Control

Under current legislation, the Diamond Act applies to the entire Sperrgebiet (DA1), as defined in Government Gazette N^{o} 97 of 3 April, 2000. This area, with the exception of the main railway line, main tar road, Lüderitz airport and a few District roads, was declared a 'Restricted Area' and subject to stringent permit conditions as specified in the Diamond Act. Within the Restricted Area, access to the diamond mining licence areas requires a different permit with even more onerous conditions.

Permit applications are required at least three months prior to the proposed visit. Clearly such conditions cannot be applied to the non-mining licence areas, if the area is to be developed as per the proposals of this land use plan. It is strongly recommended that as soon as a new management structure is in place (not before) and personnel and resources have been assigned to fence patrols and access control, the permitting process should be streamlined.

In the meantime, Namdeb have agreed to monitor and patrol the fence and to continue to apply the security clearance / permit system until a new system is in place (pers. comm. P. Lane, MET).

Conclusion

For the initial stage of getting approval in principle by Cabinet for the establishment of the Sperrgebiet as a National Park, the Management structure, but more importantly the procedure, is discussed above. Custodianship and responsibility for the park will fall under the Ministry of Environment and Tourism. This will be done subject to new legislation and their existing management structures and procedures.

However, because of the uniqueness of the Sperrgebiet (ecologically very sensitive and the number of key role players) the establishment of a Management Advisory Committee is essential. The committee will be instrumental in setting up the initial guidelines for establishing the park, and secondly, for strategic advice on an integrated management system and sustainable development policy for the area.

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Glossary of Terms and Abbreviations

Aquaculture	The controlled cultivation or farming of fish, shellfish, seaweed, or other aquatic biota.
Boundary Zone	Privately owned farmland on the eastern side of the Sperrgebiet.
CBD	Convention on Biological Diversity
CDM	Consolidated Diamond Mines
CEO	Chief Executive Officer
DA1	Diamond Area 1 – Sperrgebiet (see Map 1, page 19)
DEA	Directorate of Environmental Affairs
DKG	Deutsche Kolonialgesellschaft für Südwestafrika (German Colonial Company for South West Africa).
DNC	Directorate of Nature Conservation (pre-cursor to the DRM in MET)
DRM	Directorate of Resource Management
DWA	Department of Water Affairs
EA	Environmental Assessment
EMP	Environmental Management Plan
EMPR	Environmental Management Programme Report
GDP	Gross Domestic Product
GEF	Global Environmental Facility
General waste	A waste that, because of its composition and characteristics, does not pose a significant threat to public health or the environment if properly managed.
GNI	Gross National Income
Hazardous waste	A waste that has the potential, even in low concentrations, to have a significant adverse effect on public health and the environment because of its inherent toxicological, chemical and physical characteristics.
HWM	High water mark
LUP	Land Use Plan

LWM	Low water mark
Ma	Million years ago
MA1	Mining Area 1, one of the six mining licences granted to Namdeb under the 1994 accord
MAC	Management Advisory Committee
MAR	Mean Annual Runoff
Mariculture	The controlled cultivation or farming of fish, shellfish, seaweed, or other aquatic biota using marine water as the growing medium.
MAWRD	Ministry of Agriculture, Water and Rural Development
MET	Ministry of Environment and Tourism
MFMR	Ministry of Fisheries and Marine Resources
Mining	Any operations calculated to win any mineral or group of minerals from a mine of from any ore won from a mine, and includes any operations, which are necessary for, or incidental to, such operations. A mine is any place where mining operations are or have been carried on, an includes any excavation or accessory works which is or are necessary for, or incidental to, such mining operations.
Mm^3/a	Million cubic meters per annum
MME	Ministry of Minerals and Energy
Namdeb	Namdeb Diamond Corporation (Pty) Limited
NGO	Non-governmental Organisation
NNI	Net National Income
NNP	Namib-Naukluft Park
NVA	Net Value Added
PPMIU	Policy Planning and Management Information Unit (in the Directorate of Tourism)
Prospecting	The intentional searching, whether by way of excavations or otherwise, for any mineral or group of minerals with a view to delineating or evaluating deposits or concentrations of any such mineral or group of minerals. Any operation carried on in connection with prospecting, including any assessing, extraction or incidental winning of any mineral or group of minerals for the purposes of mineralogical examination, assaying, testwork or marketability surveys. It does not include 'mining'.
Putrescibles	Organic waste from the production of animal and vegetable based products, slaughter houses and tanneries.

STF	Southern Tourist Forum
SWAA	Administration of South West Africa
UNEP	United Nations Environmental Programme
WEC	Walmsley Environmental Consultants
WWF	World Wide Fund for Nature

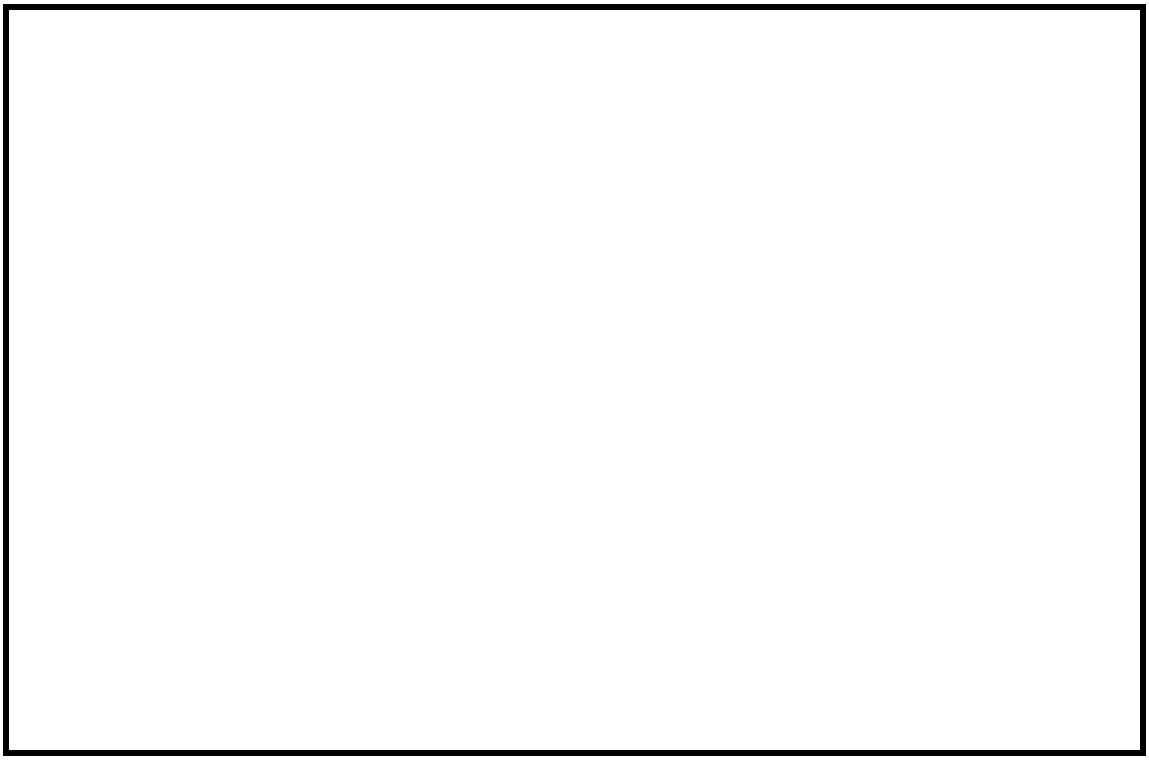

Plate 1: Windswept valley between Bogenfels and Pomona

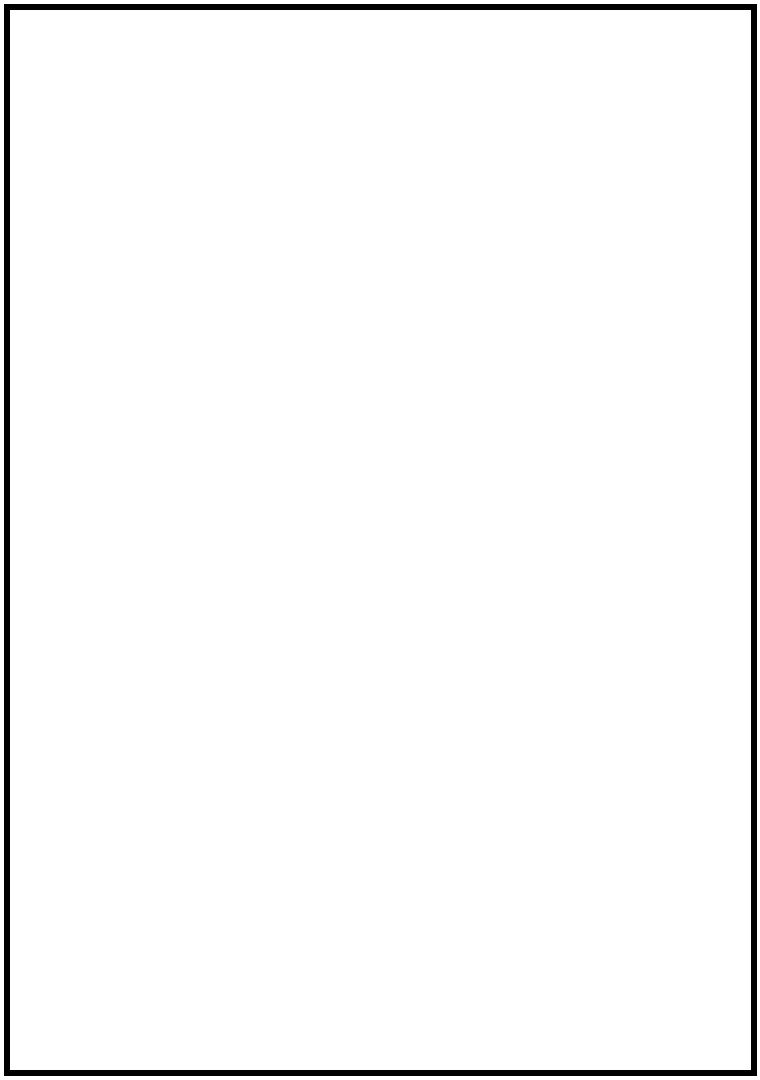

Plate 2: Africa Rock, Aurusberg

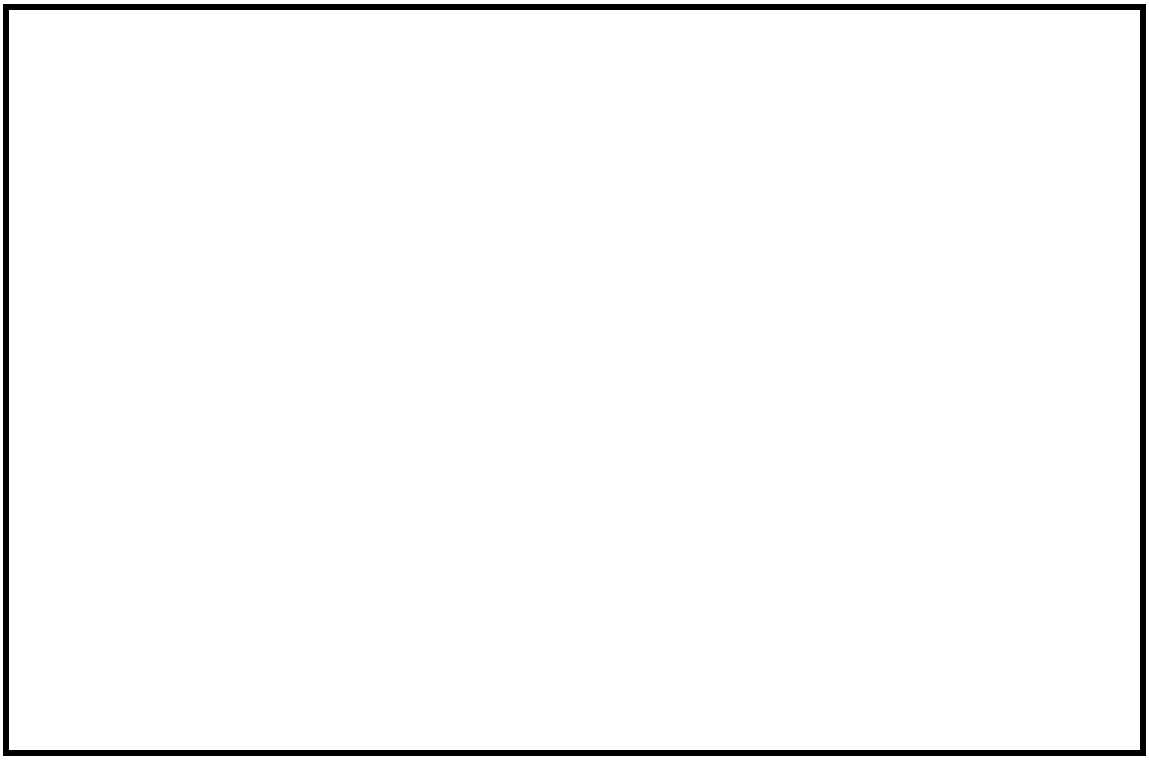

Plate 3: Grassy plains near Rooiberg supporting several hundred gemsbok and springbok (May, 2000)

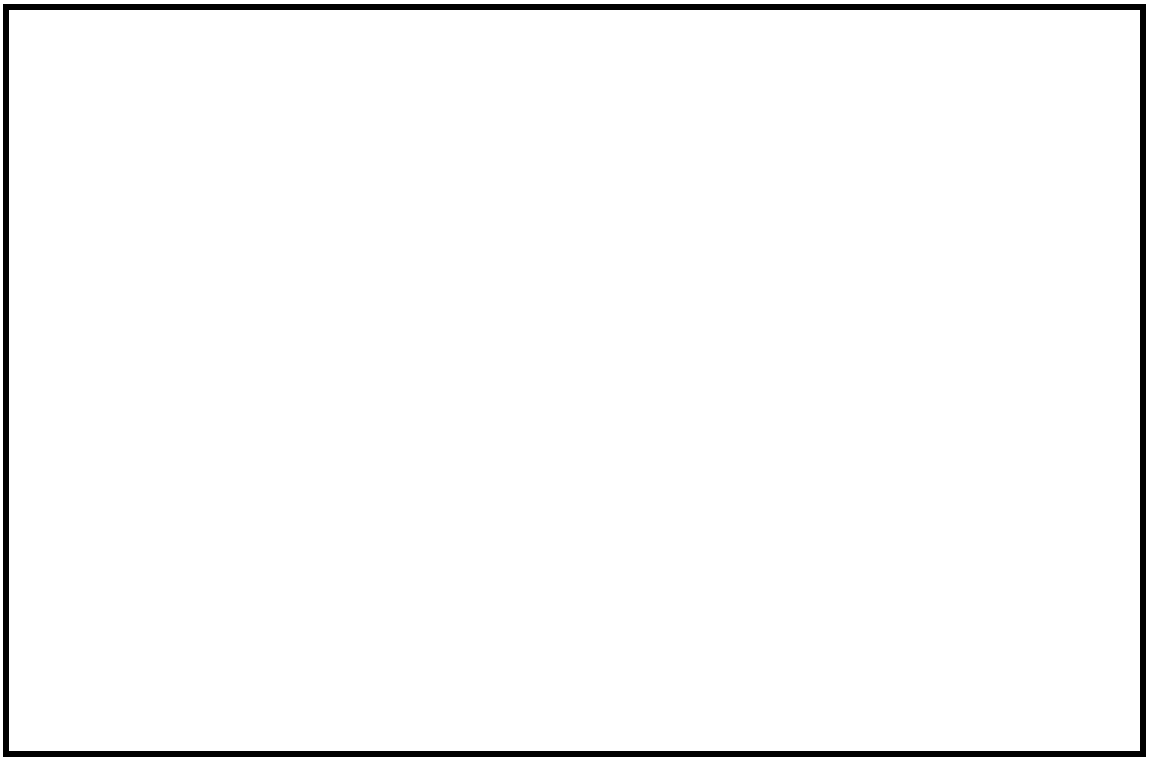

Plate 4: Distant view of the Roter Kamm crater from Aurusberg

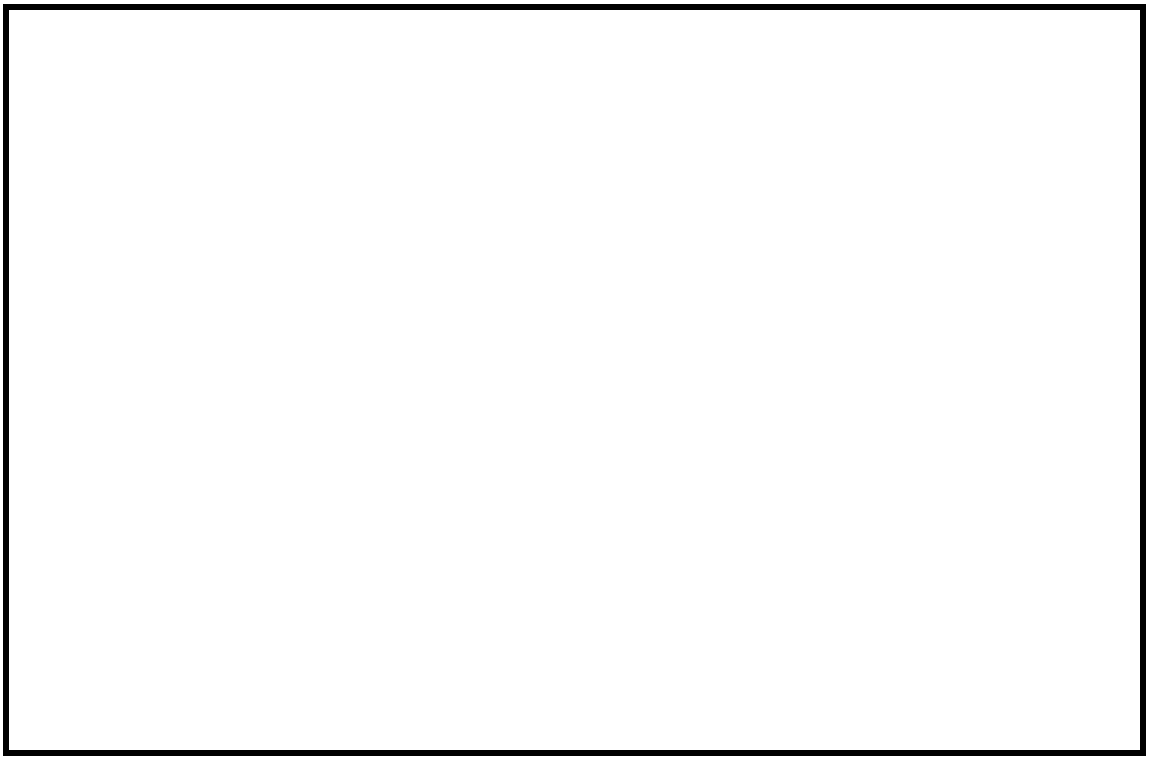

Plate 5: Massive quartzites outcropping along the dry Kaukausib valley

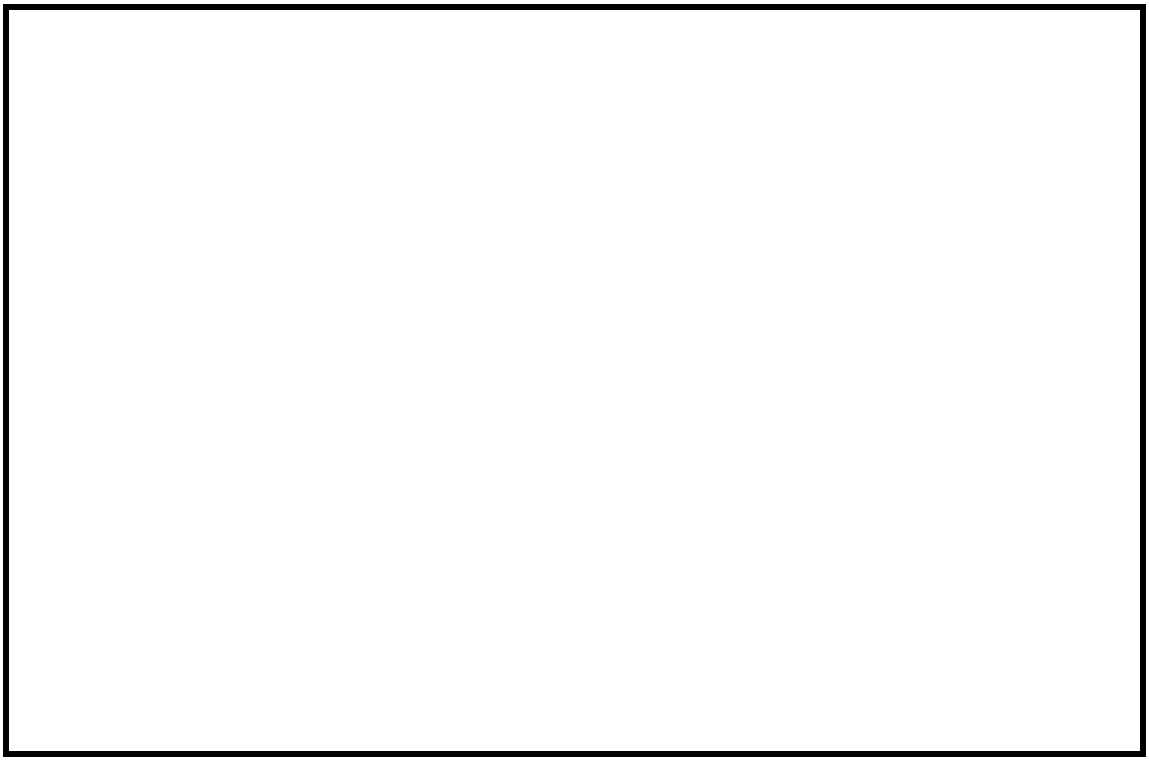

Plate 6: Sedimentary rocks at Tsaus. Note gravel plain in foreground

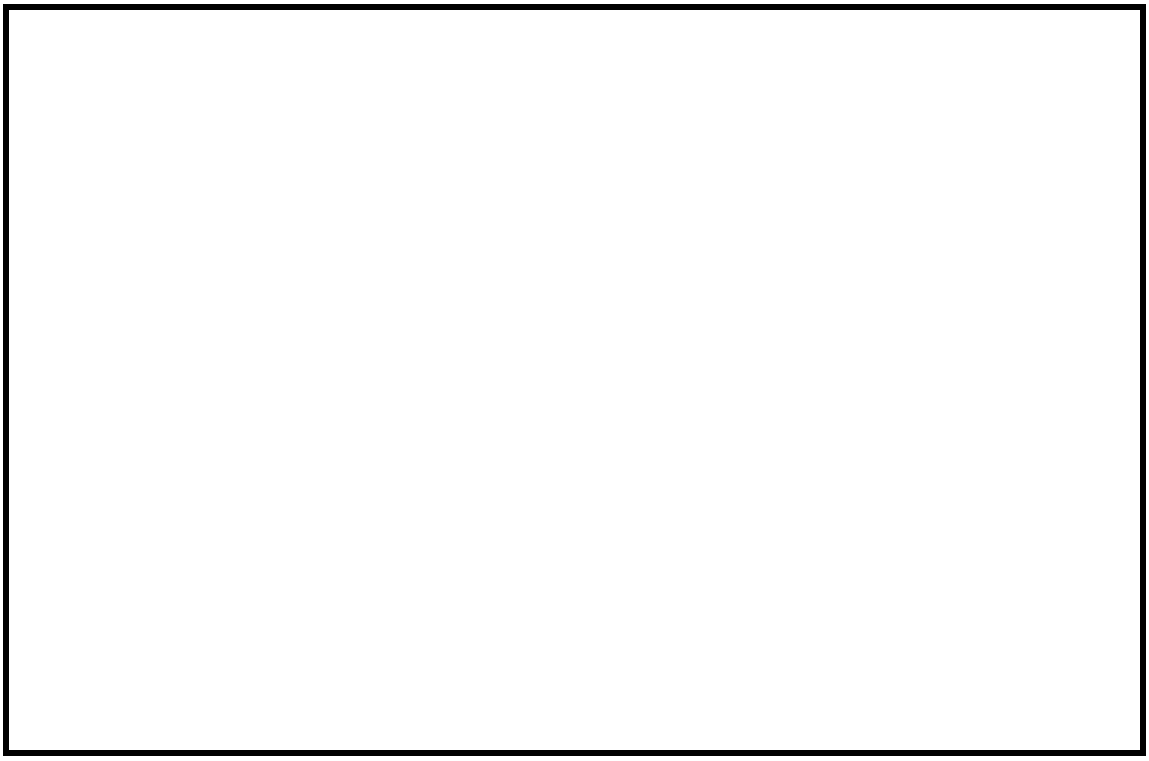

Plate 7: Volcanic rocks of the Klinghardtberge

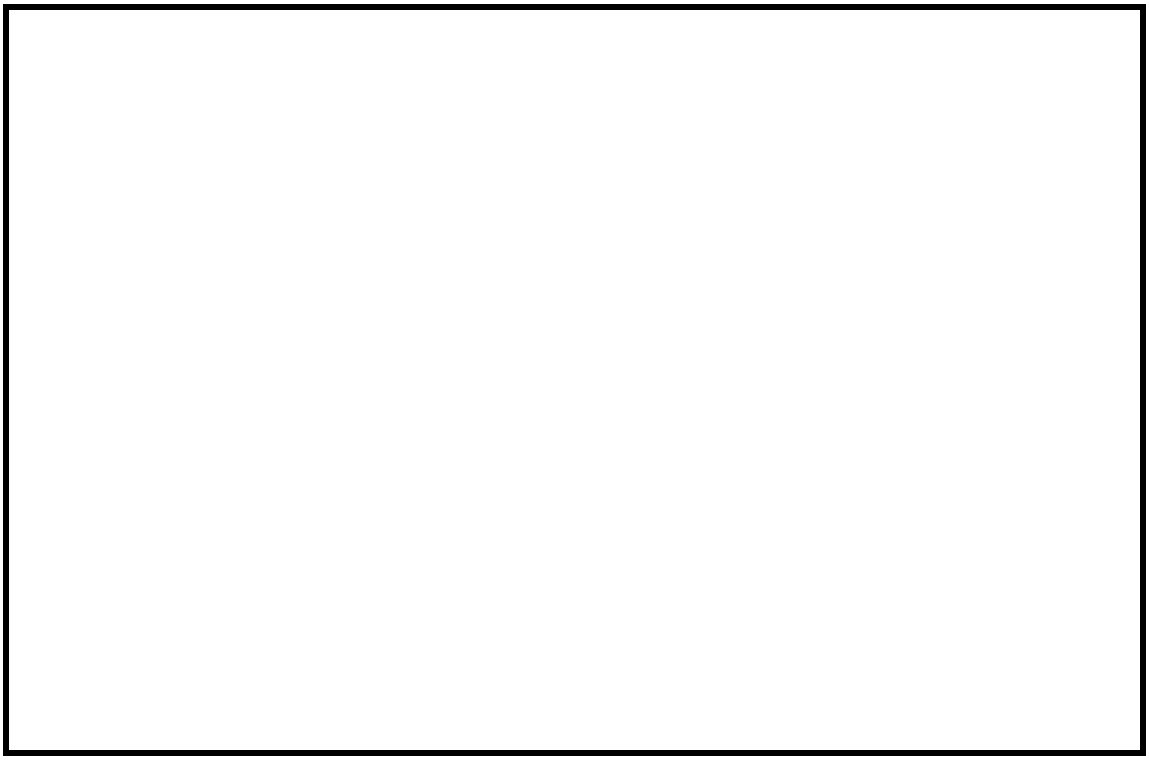

Plate 8: Complex geology of the Gomtsawibberge

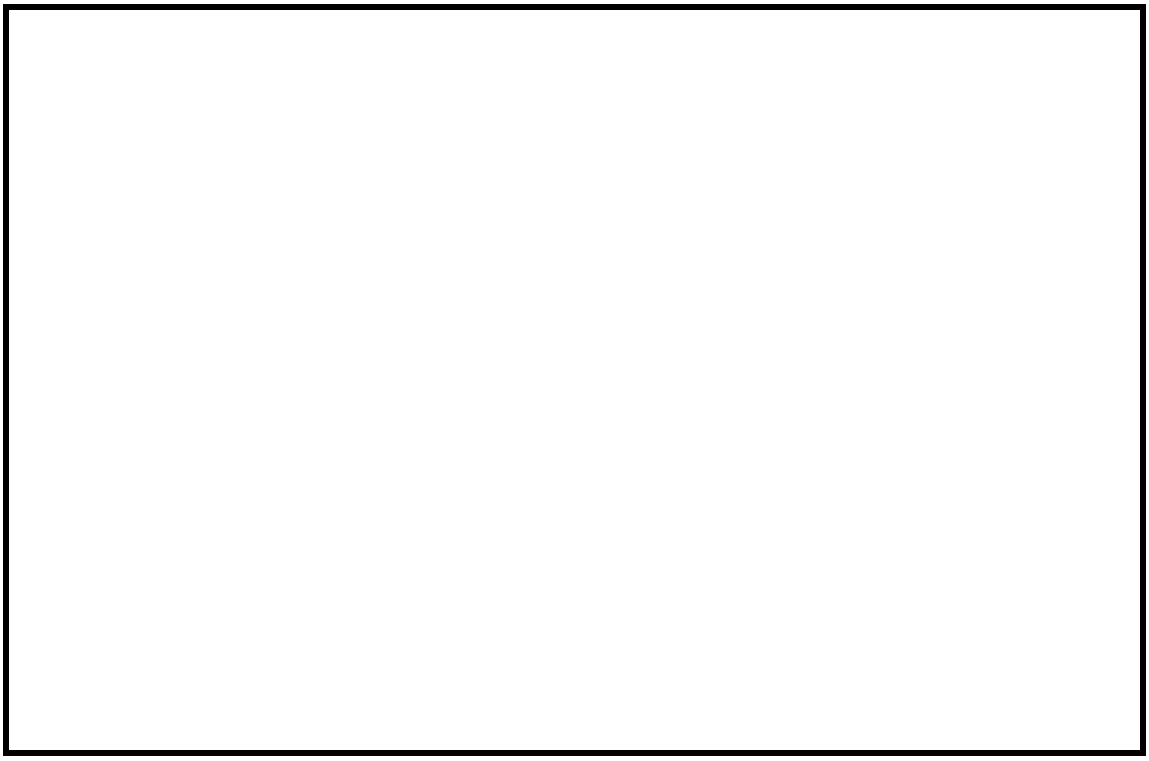

Plate 9: Hypersaline habitats in and around Pink Pan, near Oranjemund

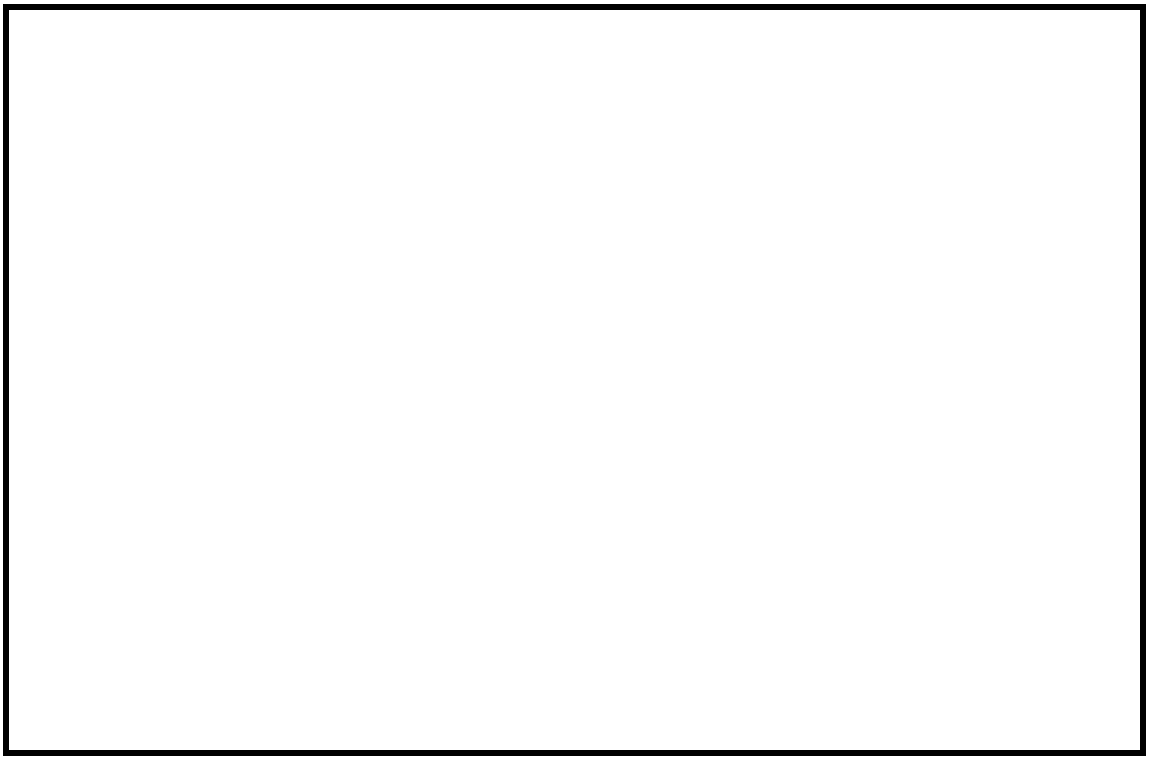

Plate 10: Featureless sand sheets north-east of Oranjemund

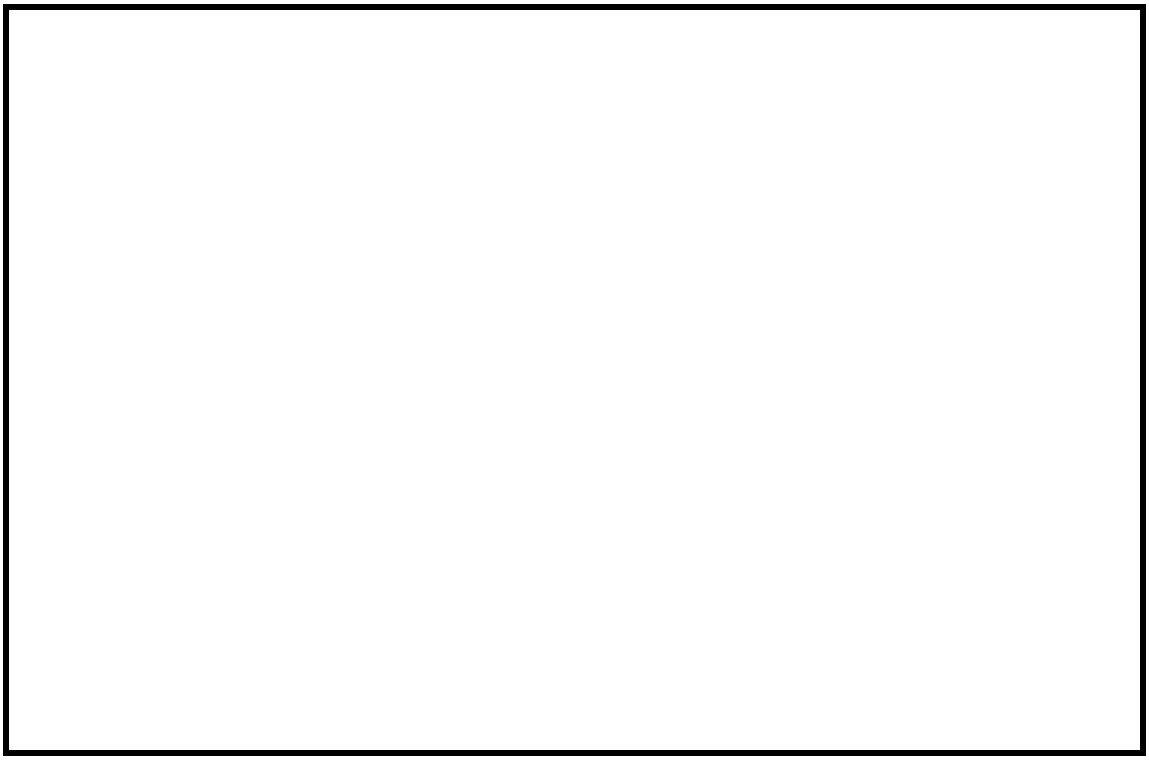

Plate 11: Towering red dunes near Tsaus

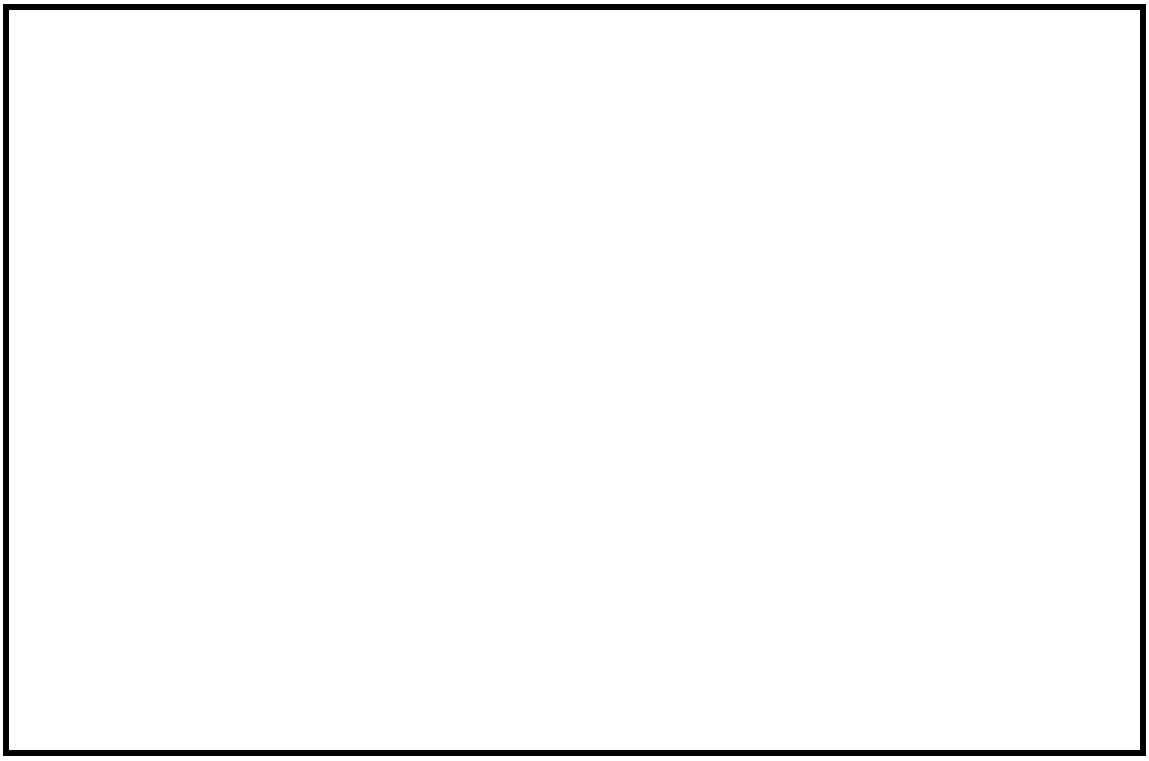

Plate 12: The Namib sand sea north of Lüderitz. Note star dunes and linear dunes

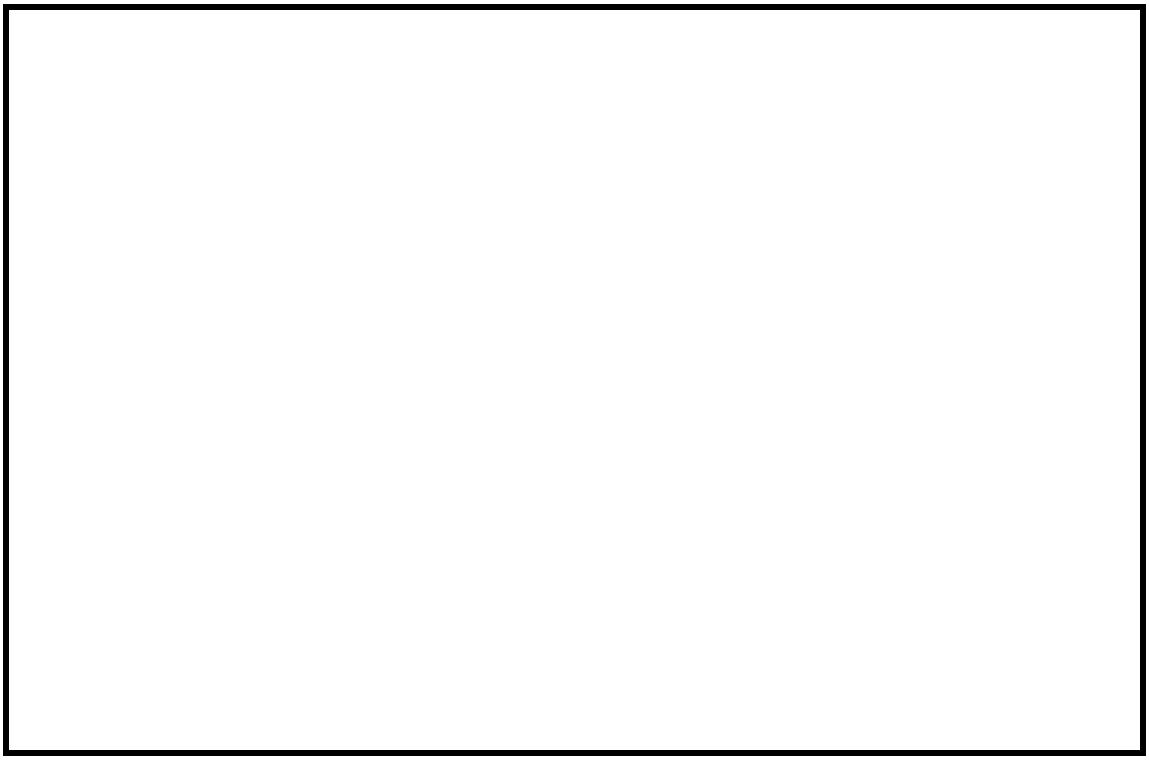

Plate 13: Highly mobile barchan dunes moving through the Klinghardtberge

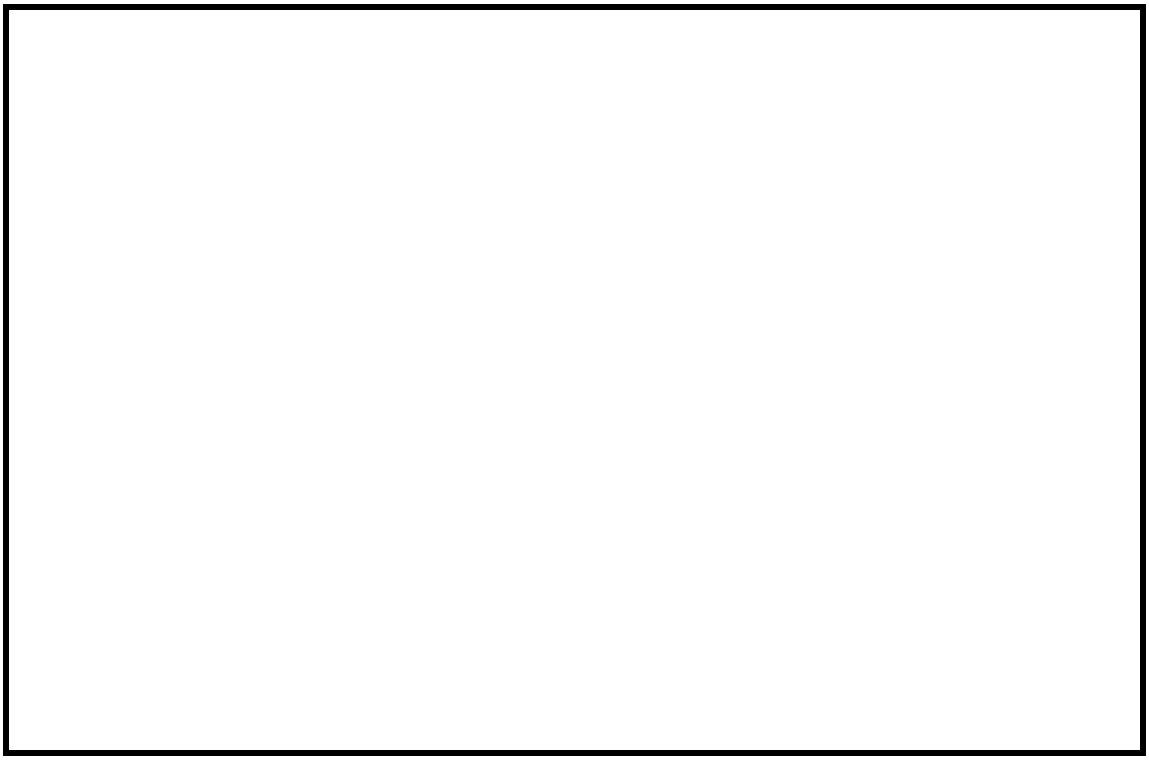

Plate 14: Orange River

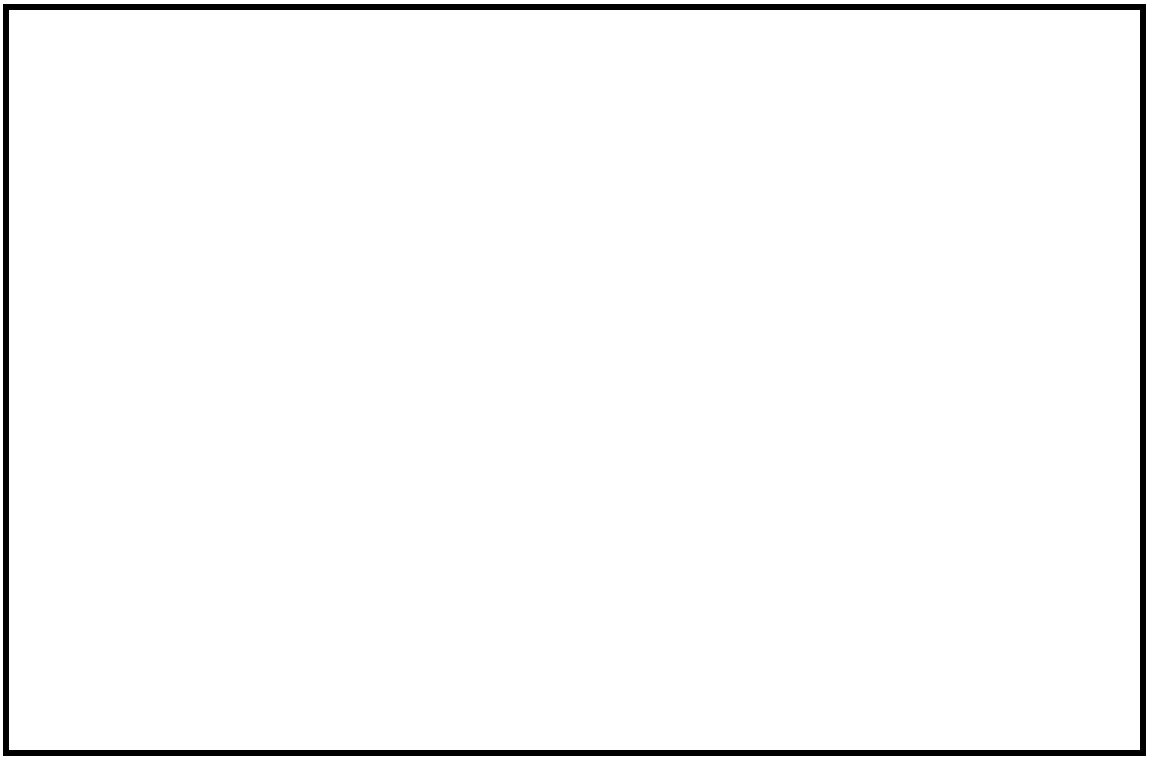

Plate 15: Bogenfels Arch

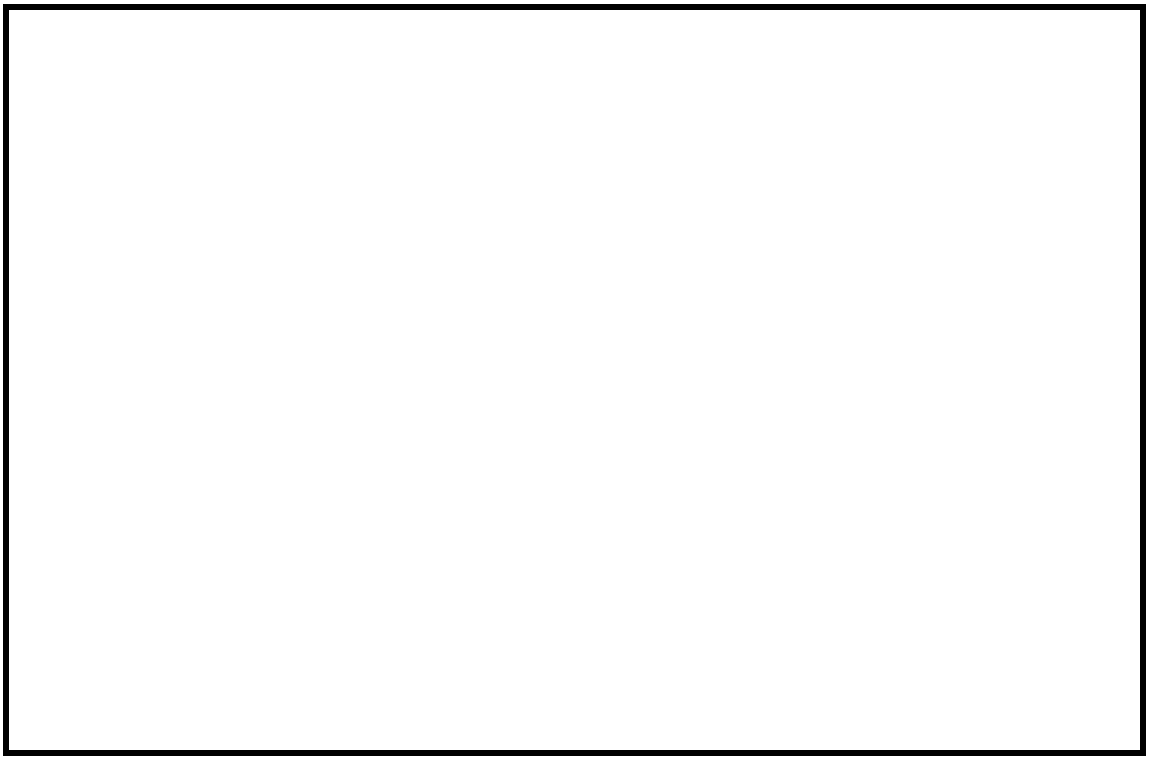

Plate 16: The Ramsar Site at the Orange River mouth

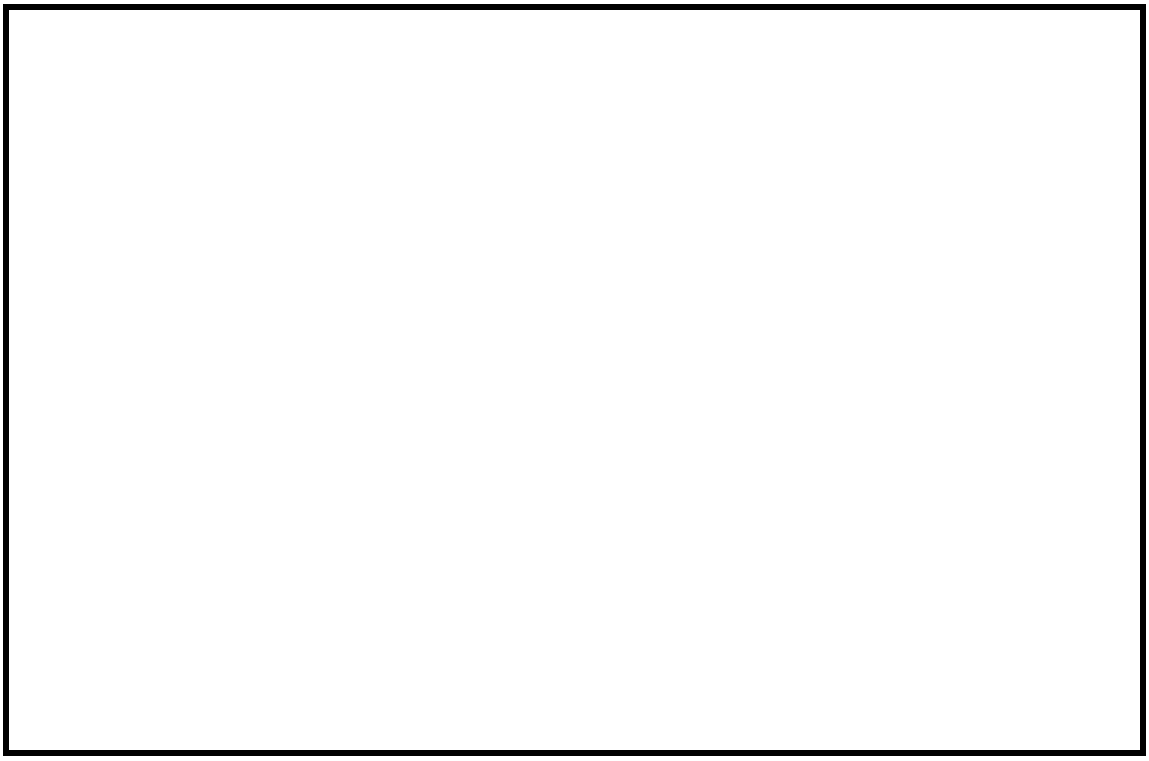

Plate 17: Dried up mud and some standing water at Anib Pan. Note old infrastructure of Borehole 3

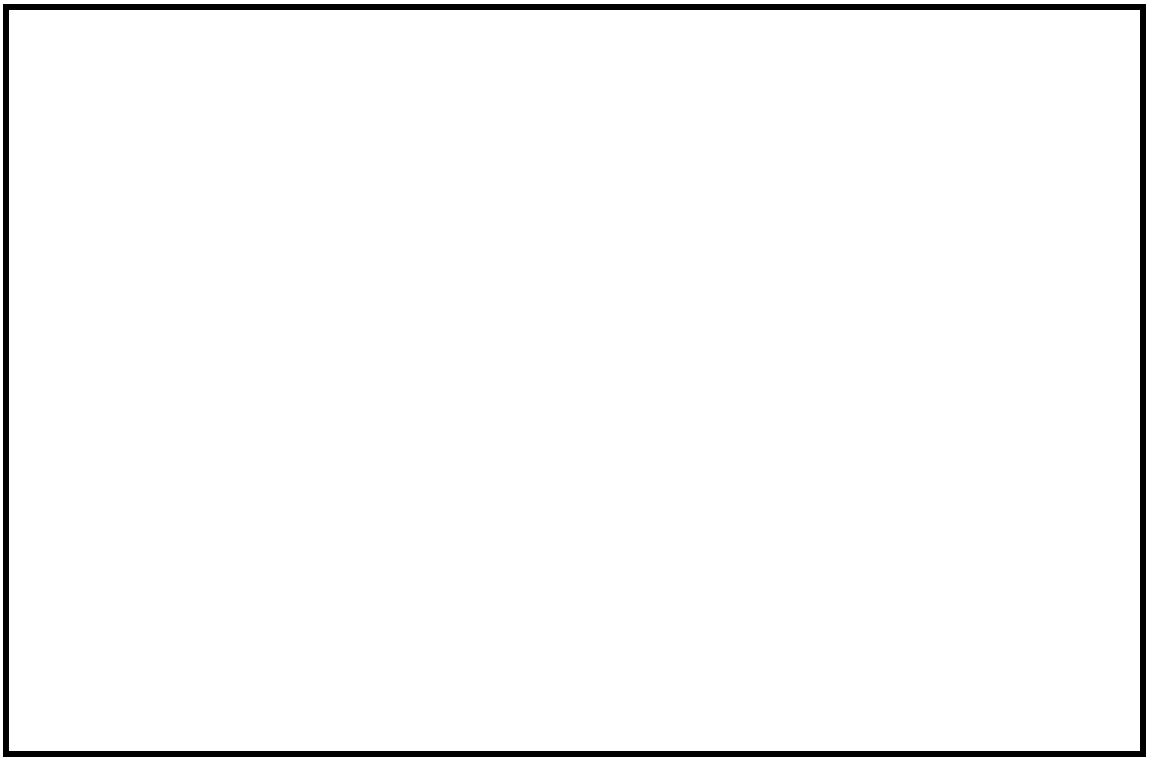

Plate 18: Kaukausib Fountain. Note debris left lying around. This fountain is extensively used by gemsbok

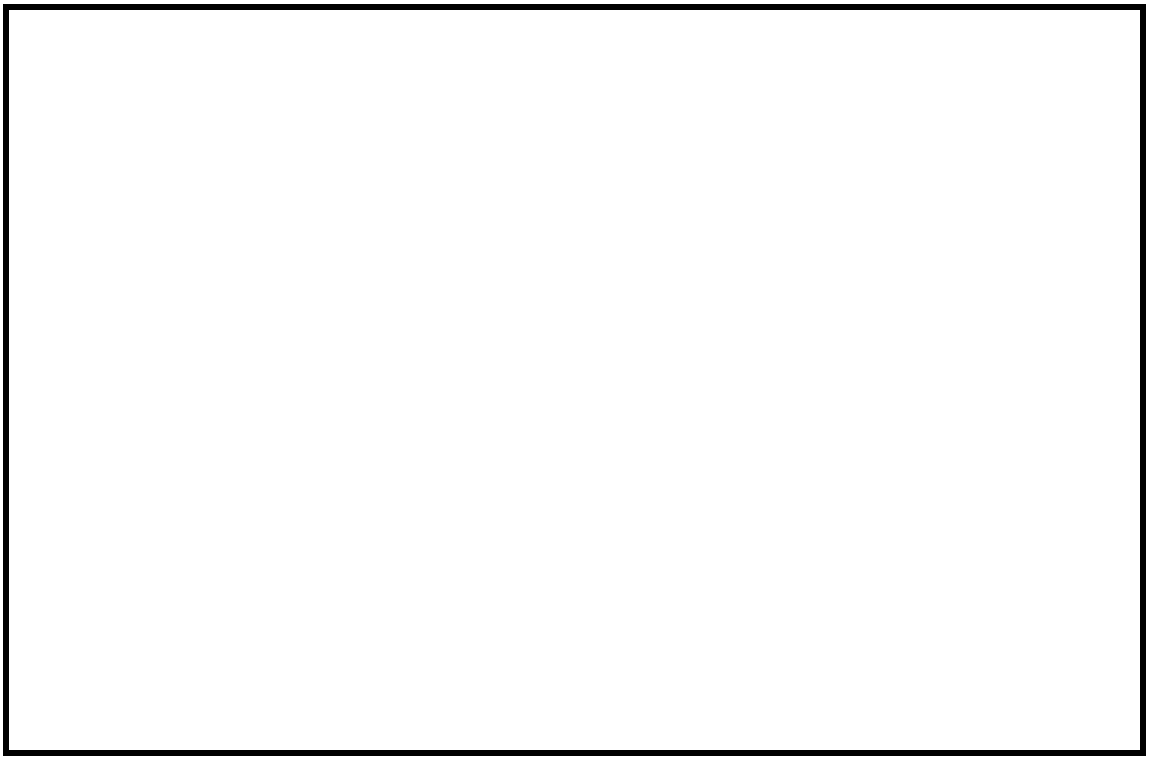

Plate 19: Typical hummock vegetation near Oranjemund

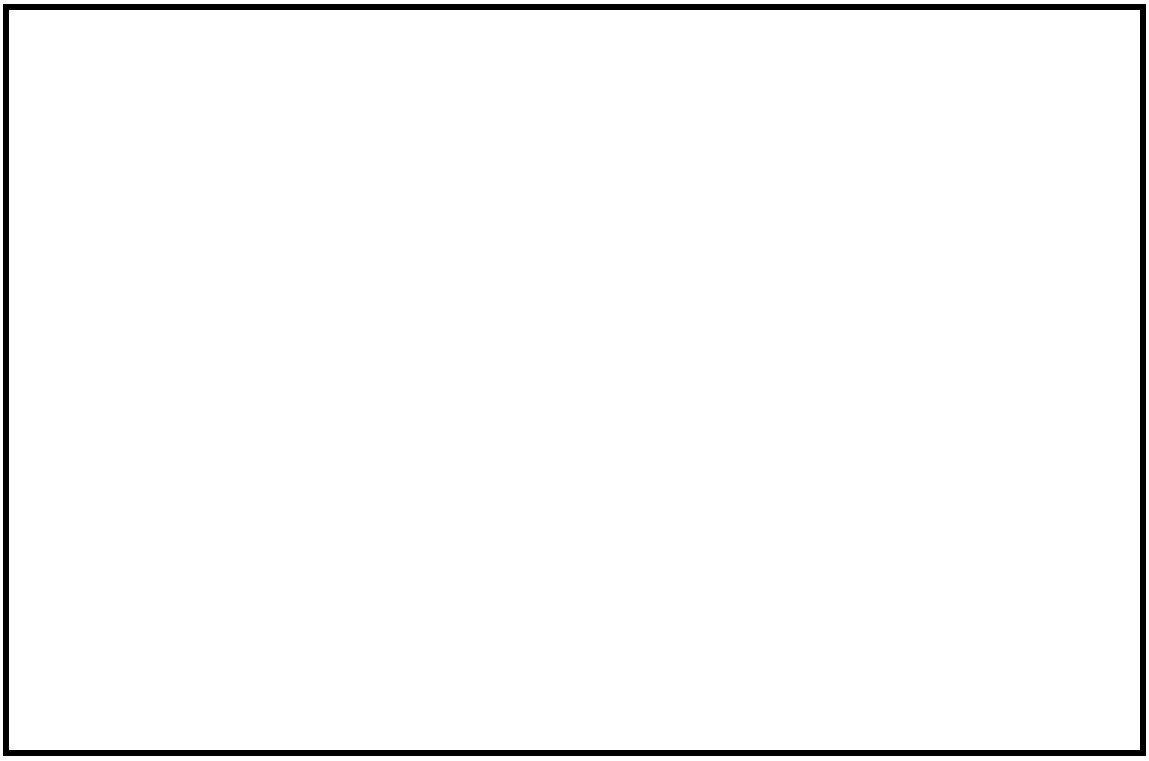

Plate 20: Denser and more varied vegetation in the Aurusberg. Note *Aloe ramosissima* in foreground

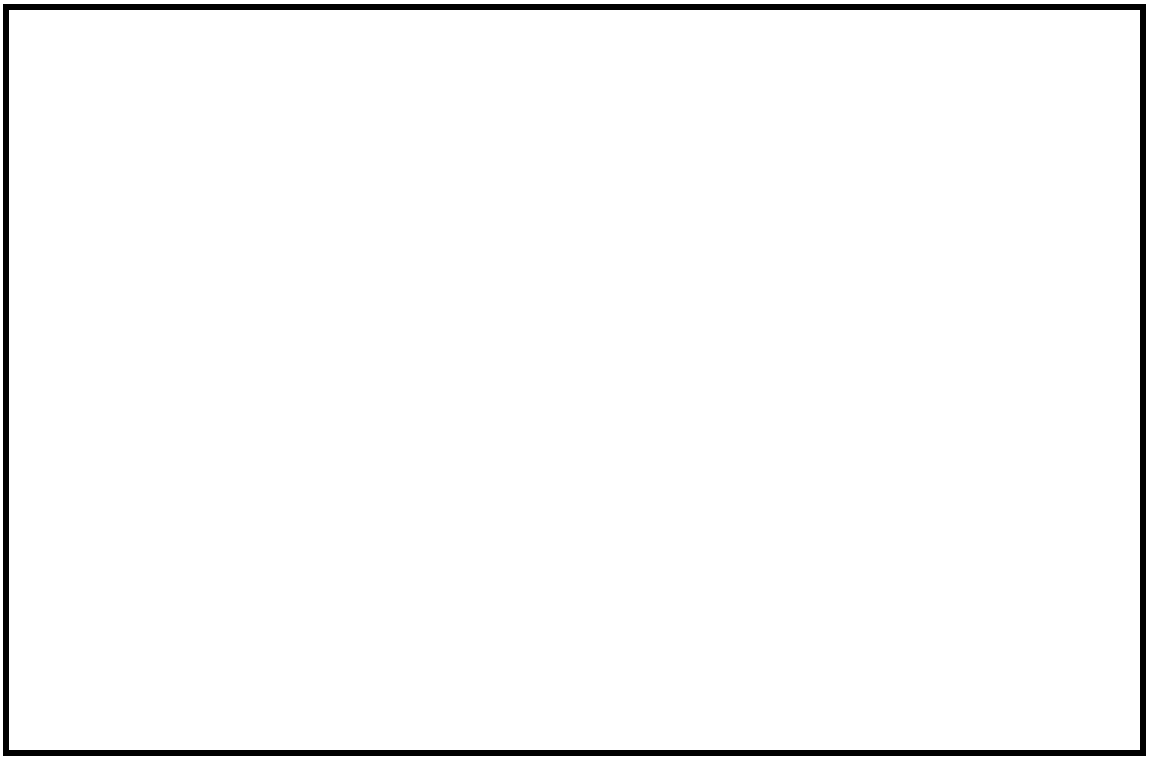

Plate 21: ***Aloe erinaceae***

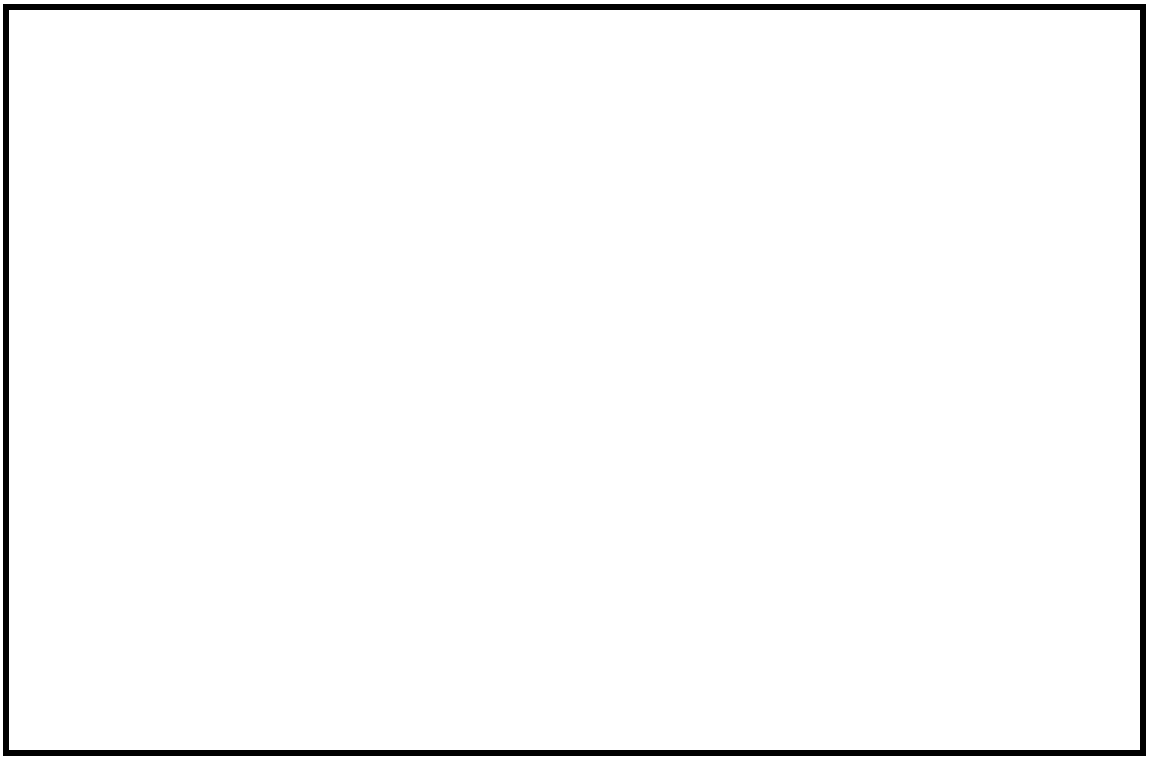

Plate 22: The wild horses of Garub

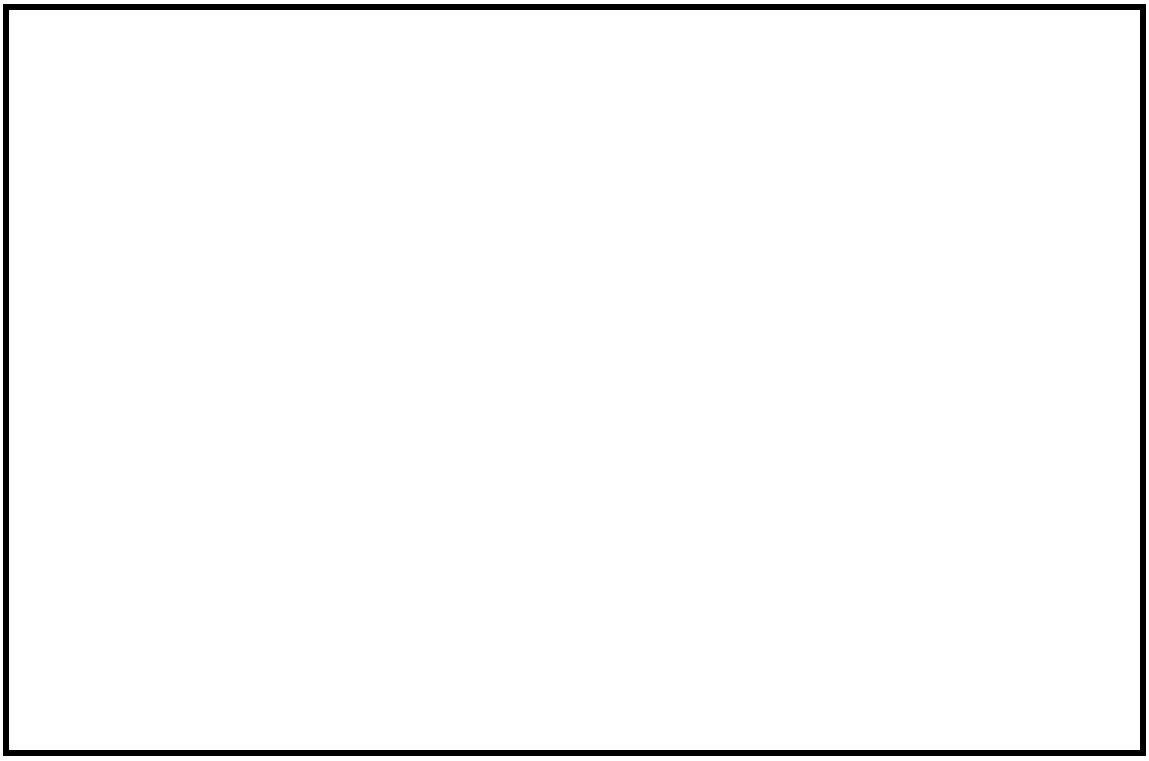

Plate 23: Camel thorn (*Acacia erioloba*) near Borehole 5. Note well-defined grazing line

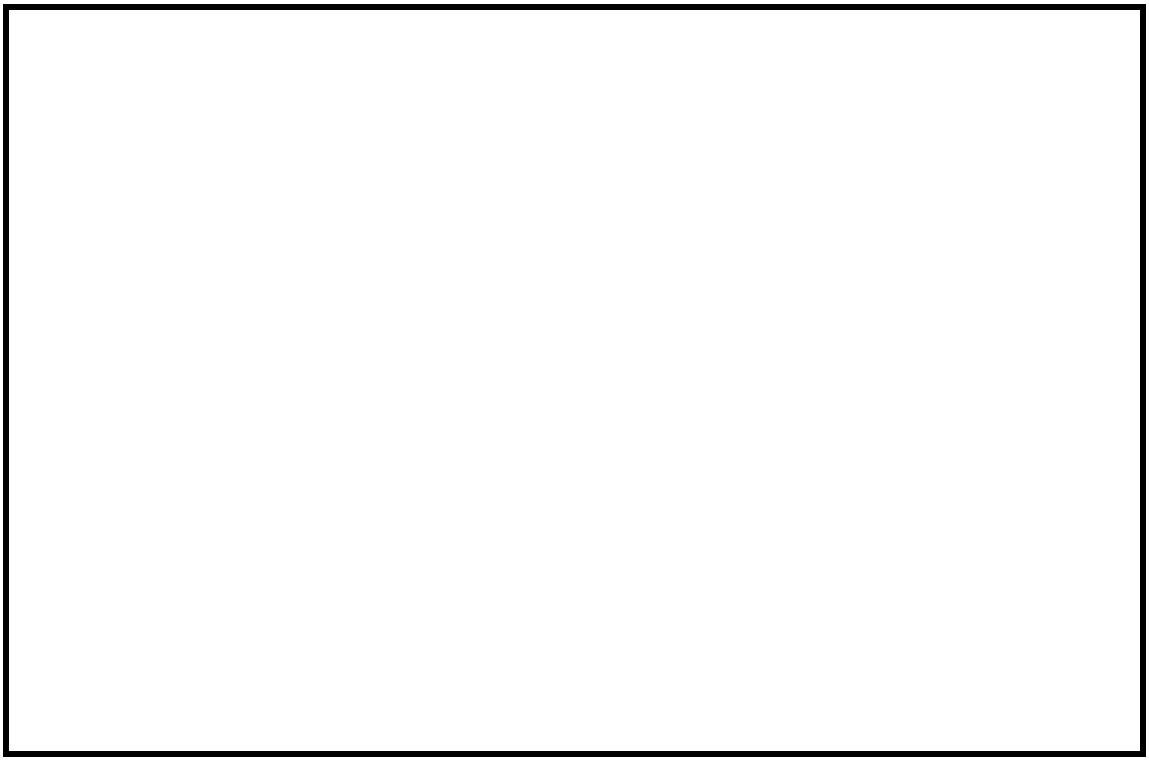

Plate 24: Early flowers (May) near Rosh Pinah

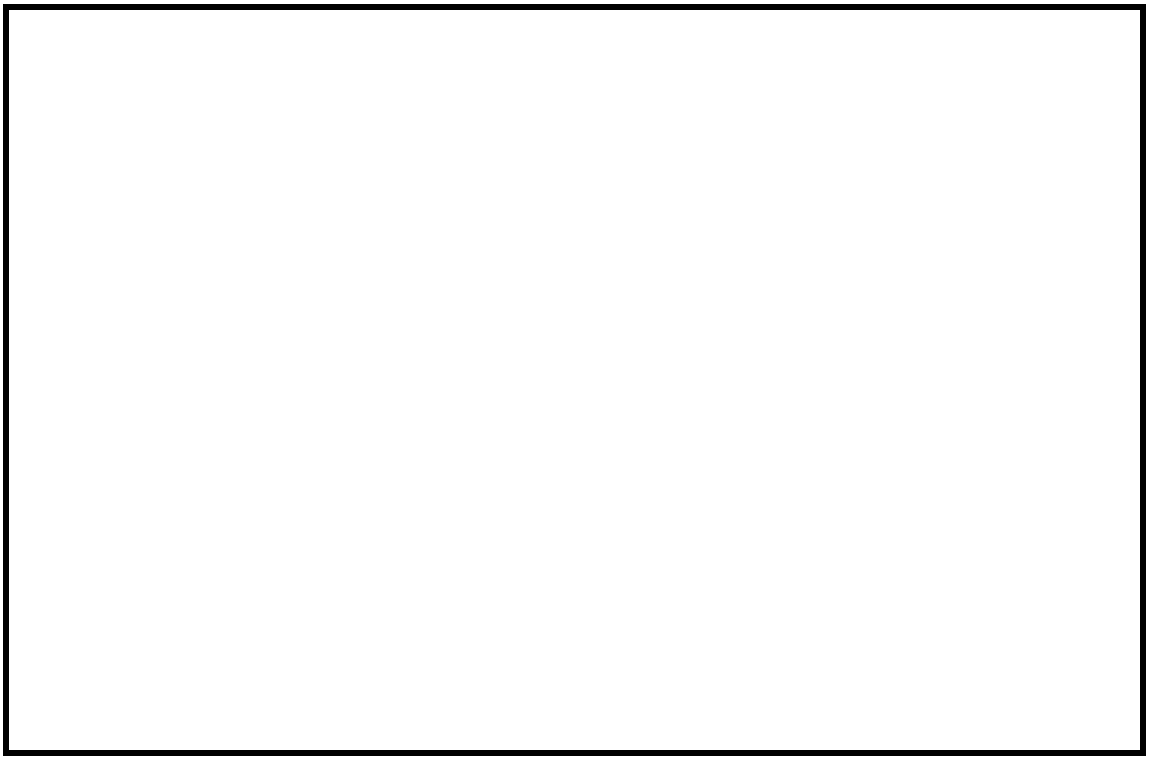

Plate 25: View across the Orange River towards the Richtersveld

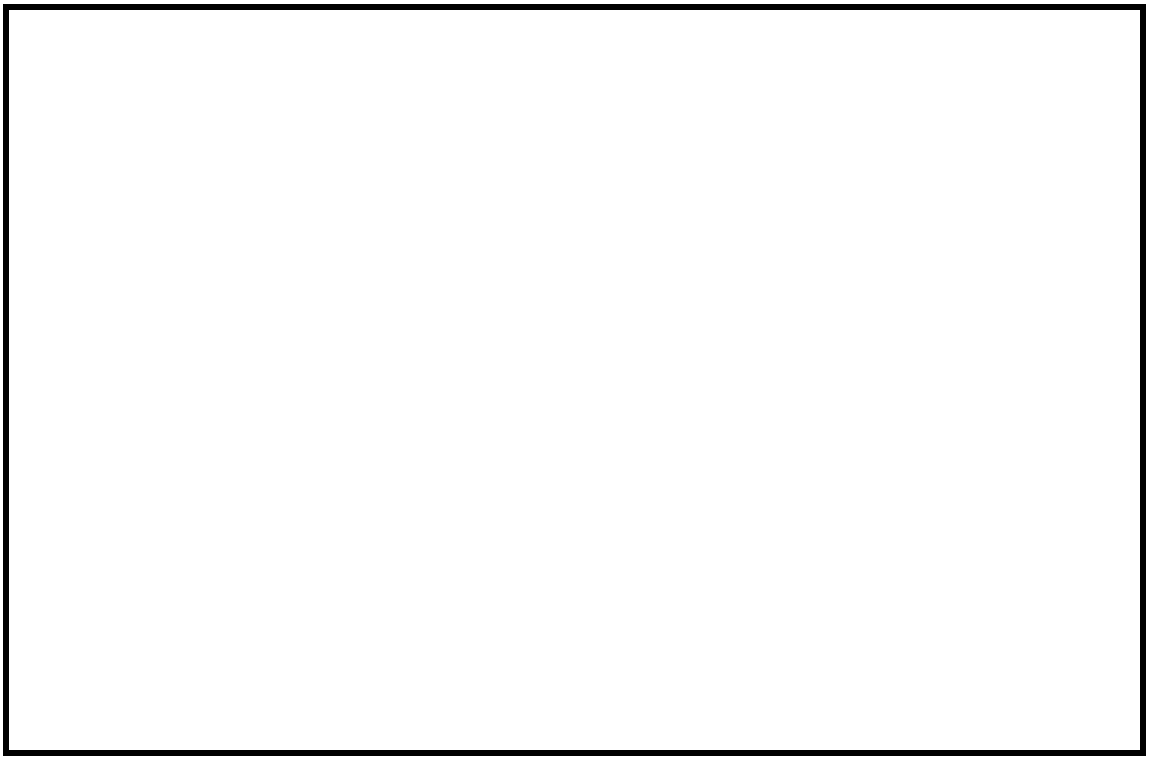

Plate 26: The Huib-Hoch Plateau lies in the Boundary Zone to the east of the Sperrgebiet

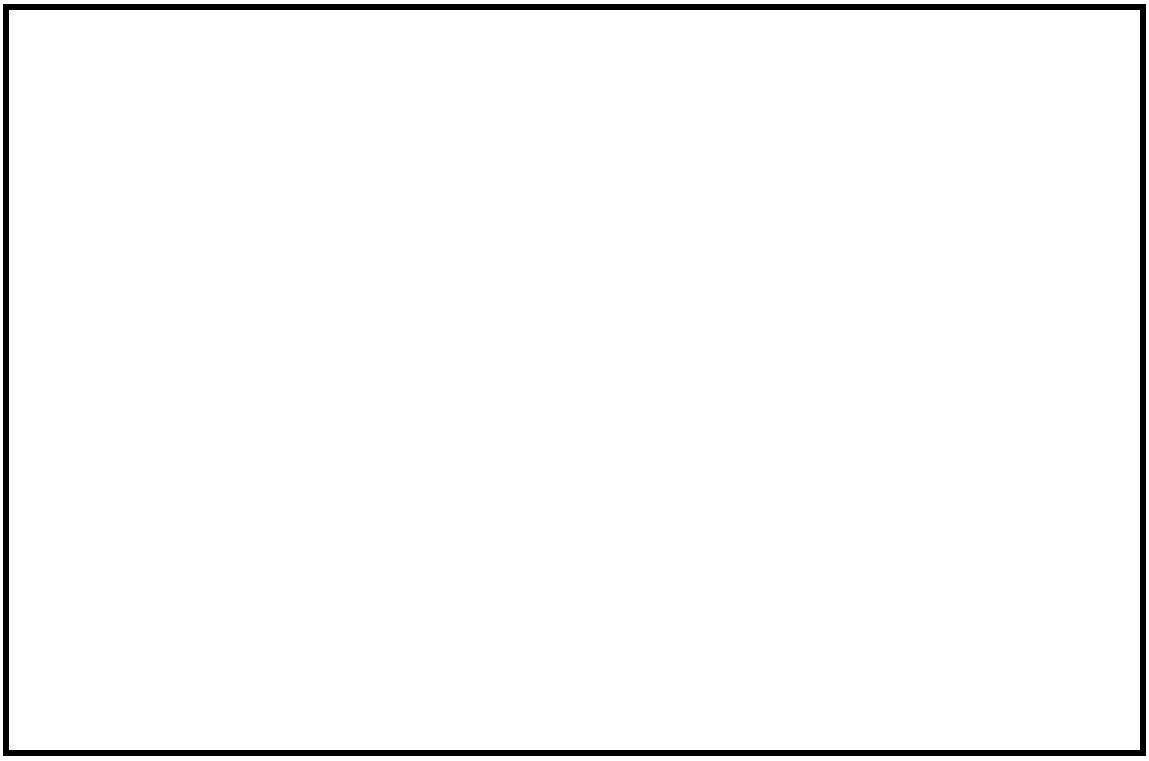

Plate 27: Waterfalls, cliffs and a high diversity of plants characterise the Huib-Hoch Plateau

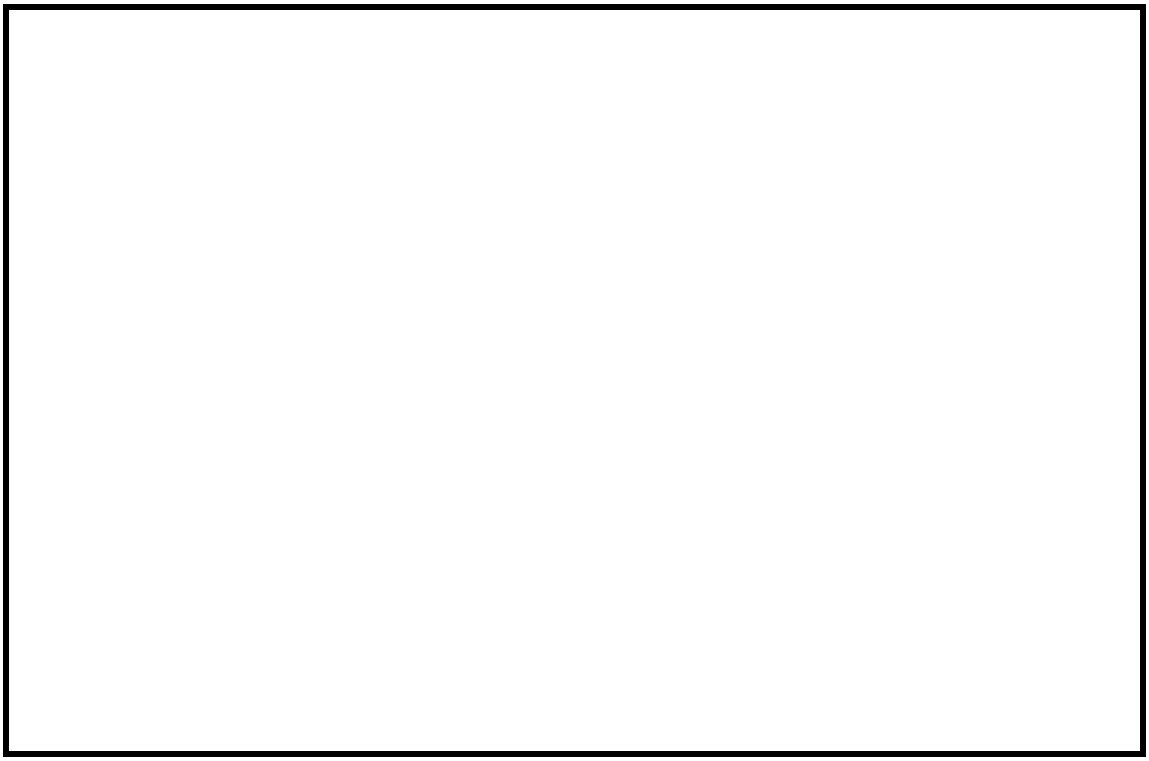

Plate 28: The dunes rise over 300 m over the Koichab in the Namib-Naukluft Park. Note the large Camel thorn (*Acacia erioloba*)

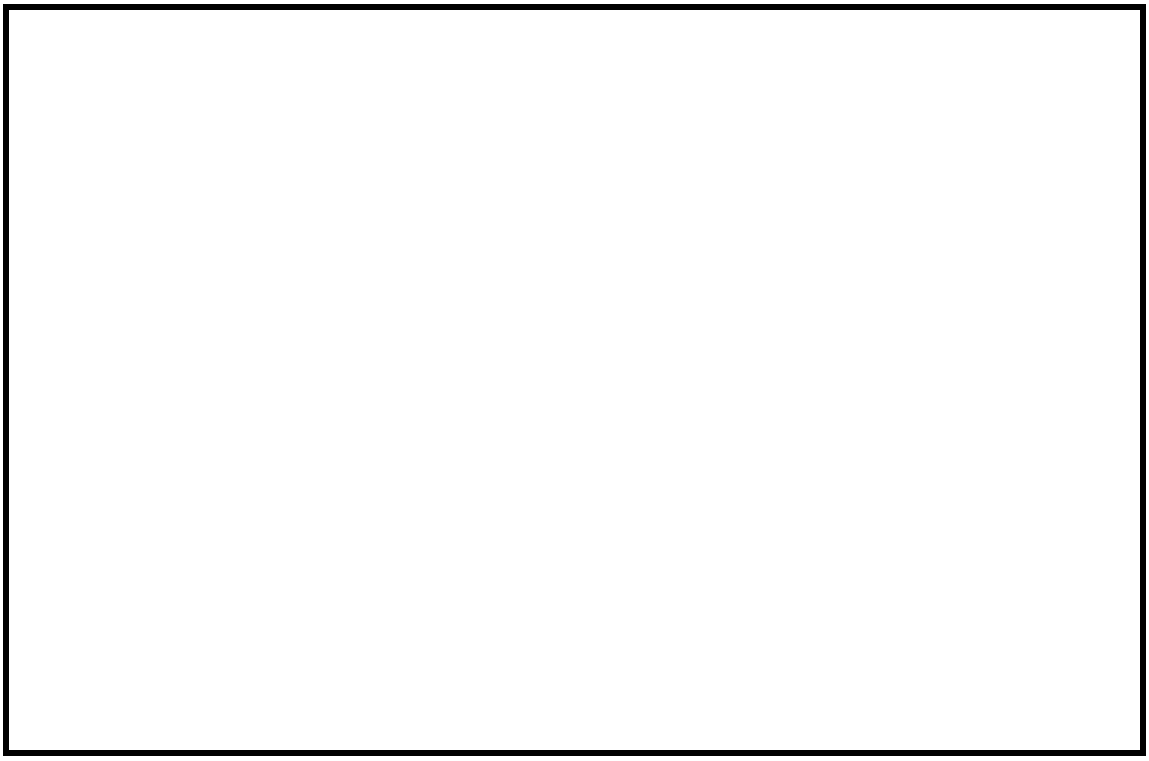

Plate 29: Dikwillem

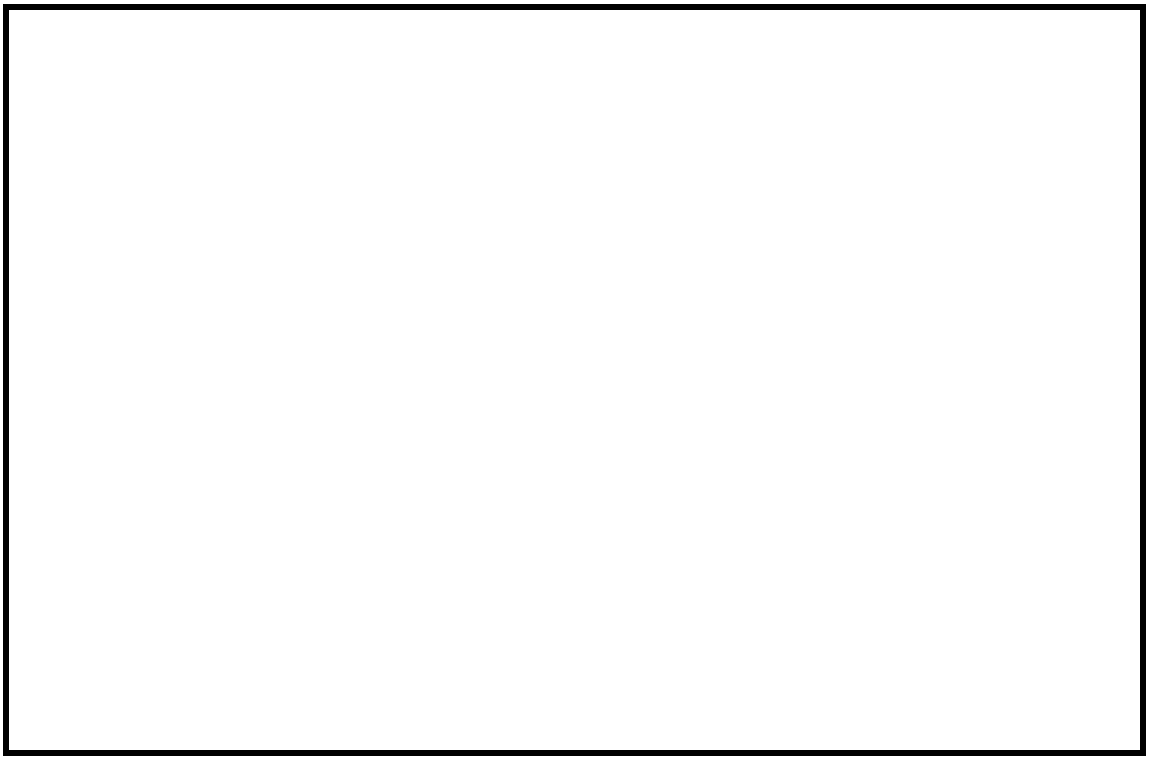

Plate 30: Old waterfalls have eroded pools into the massive granites of Kirchberg in the Namib-Naukluft Park

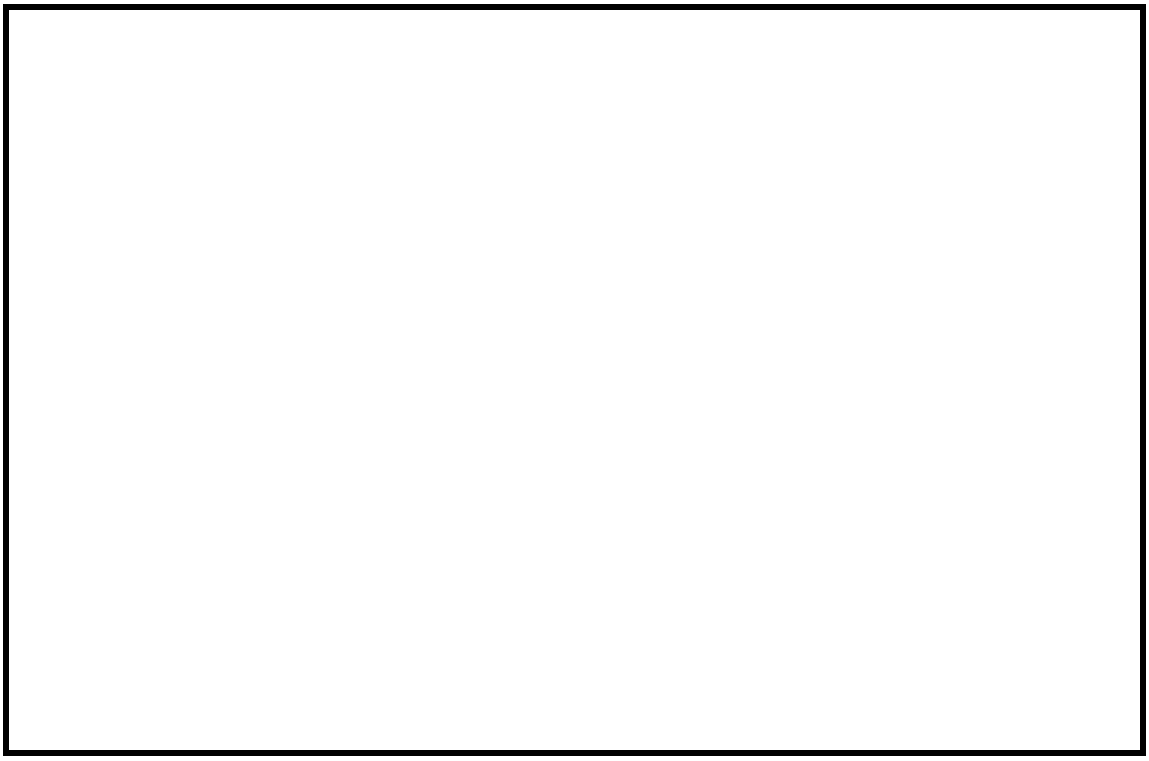

Plate 31: Herds of gemsbok on the grassy plains near Giams

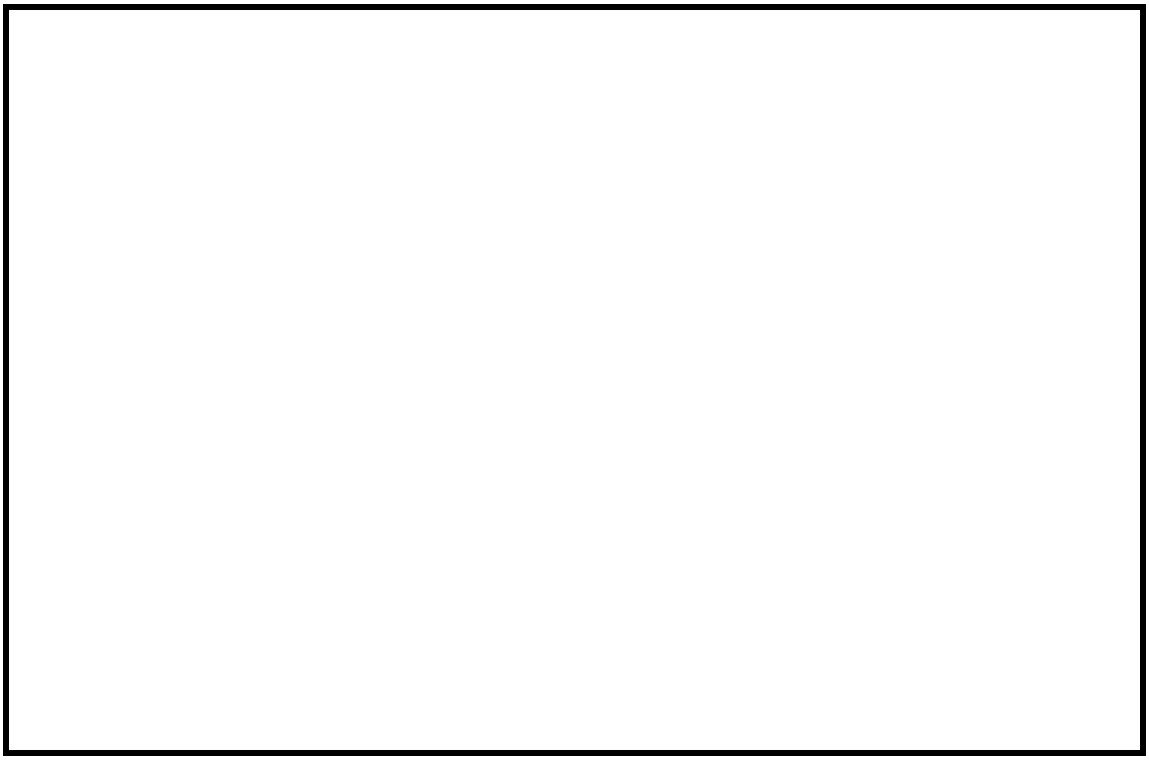

Plate 32: Spectacular scenery in the north-eastern Sperrgebiet

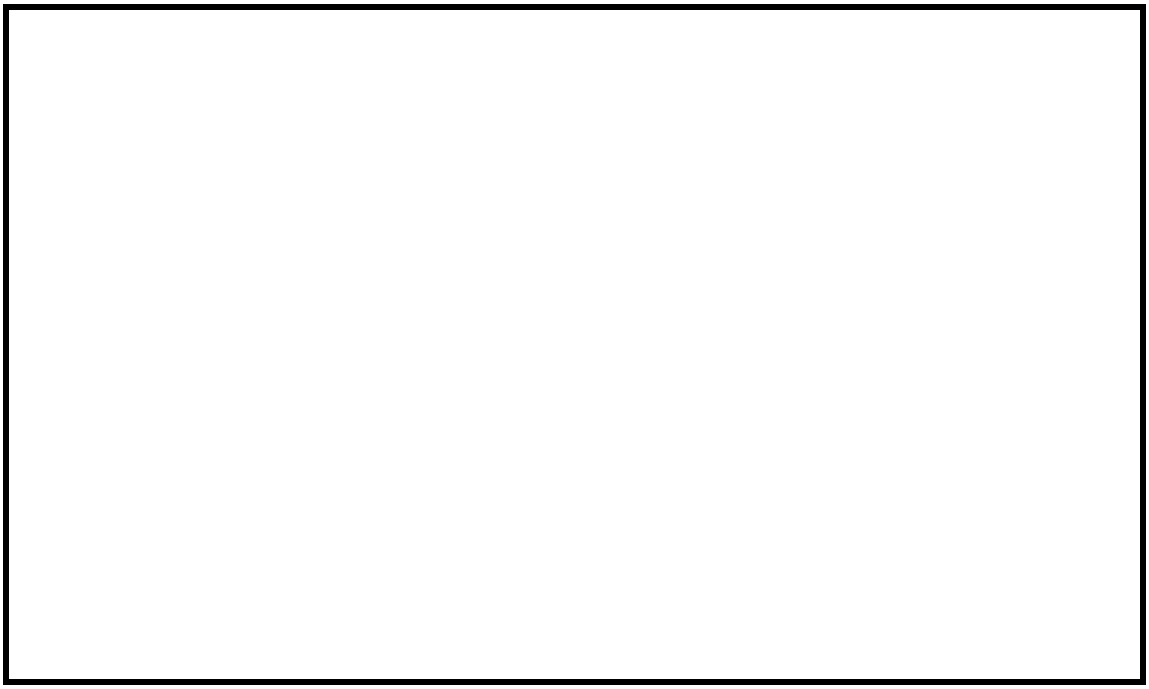

Plate 33: Old buildings at Bogenfels Mine

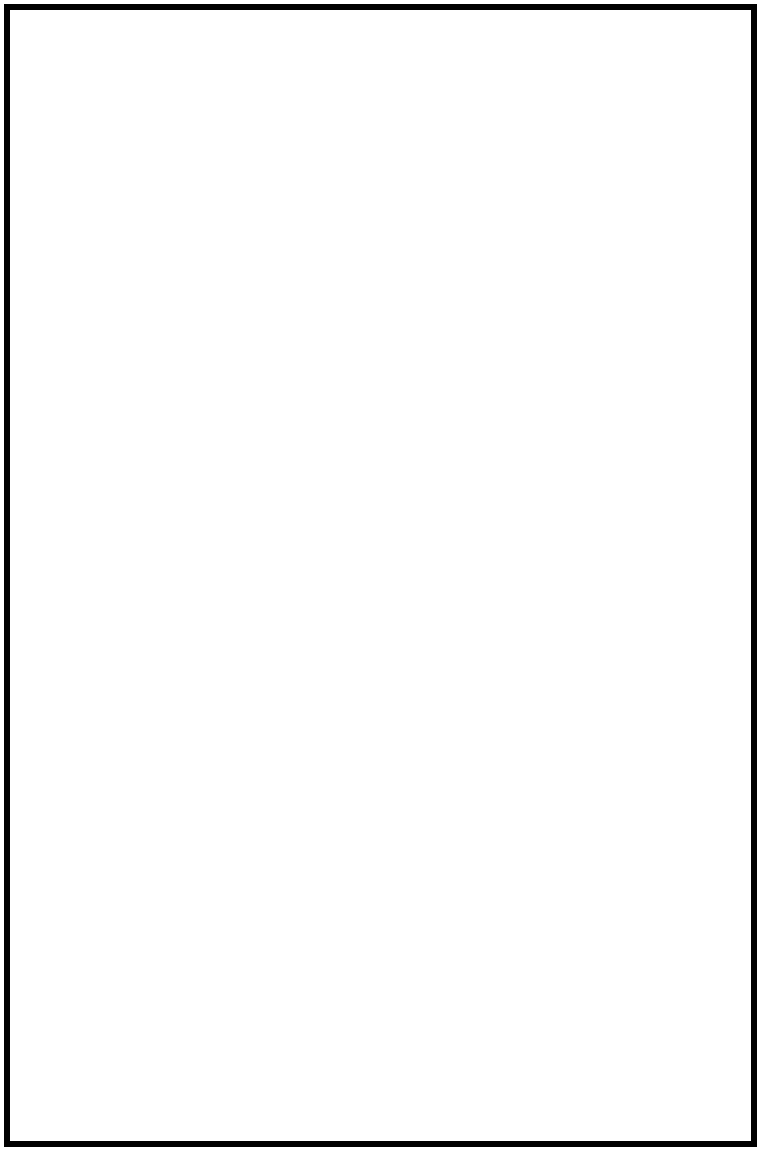

Plate 34: Sand-filled doorway at Bogenfels Mine

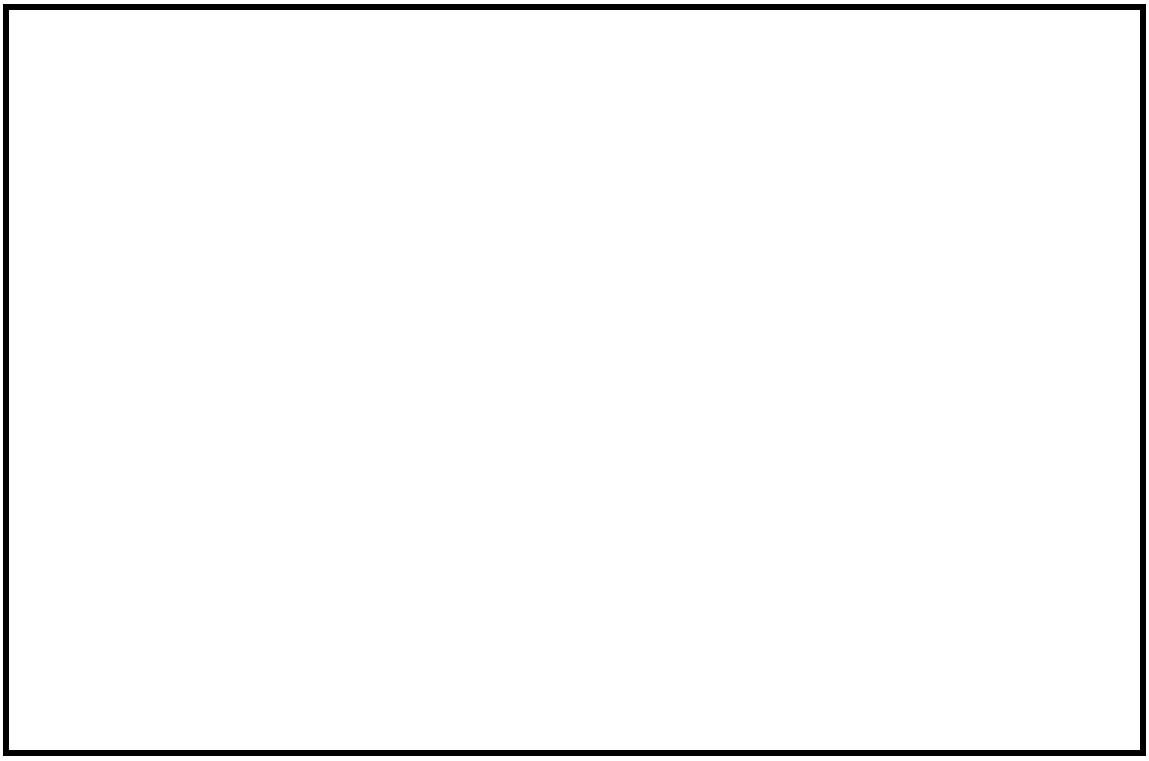

Plate 35: Old narrow-guage railway to Pomona and Bogenfels Mines

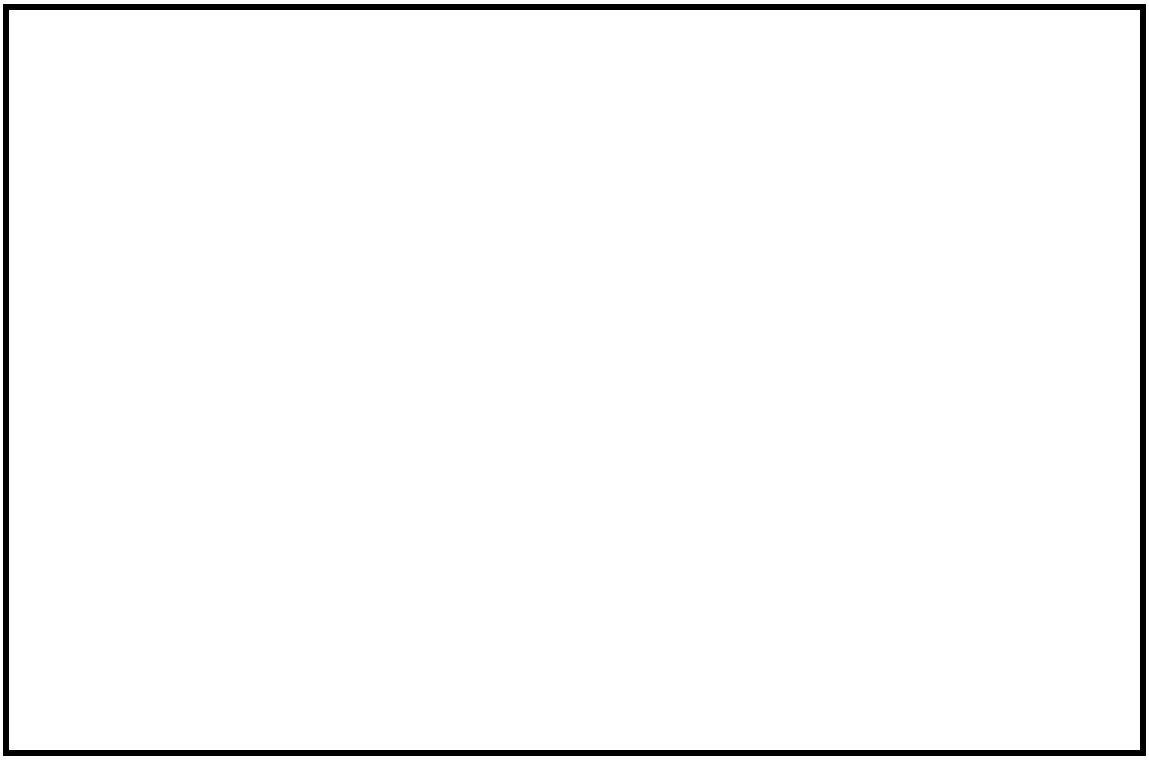

Plate 36: Parallel tracks

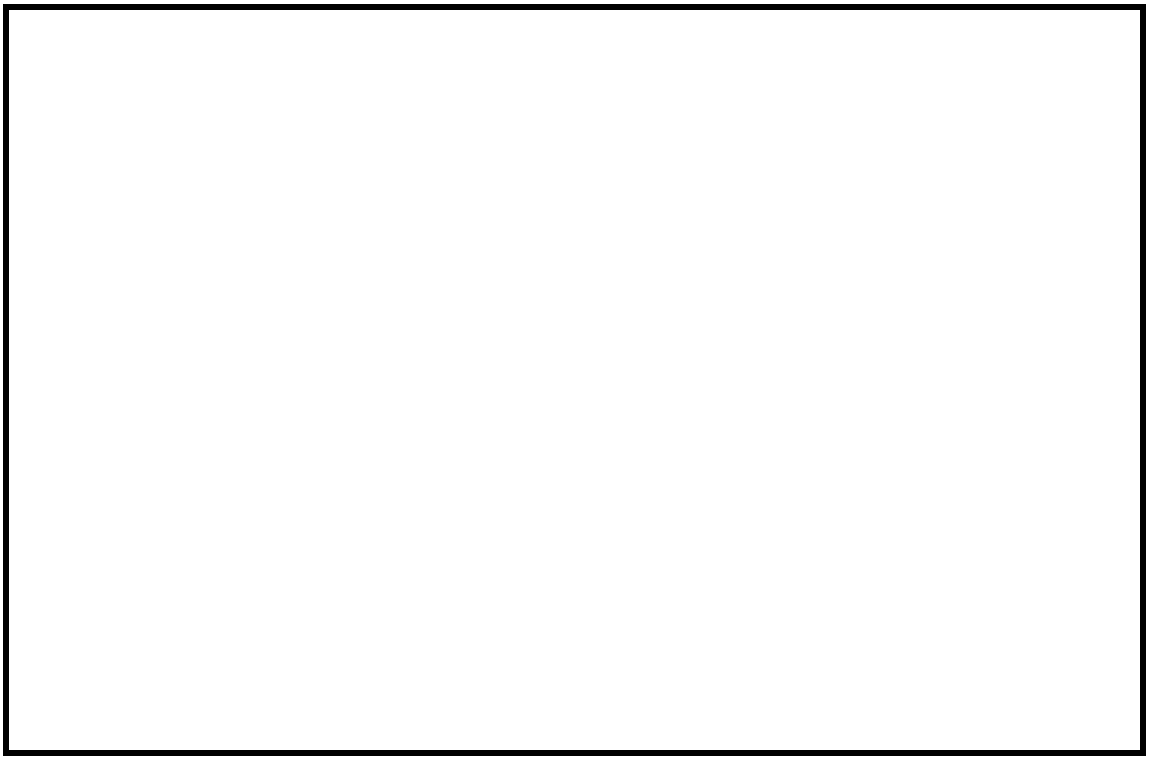

Plate 37: 66 kV power line from Lüderitz to Rosh Pinah near Agub

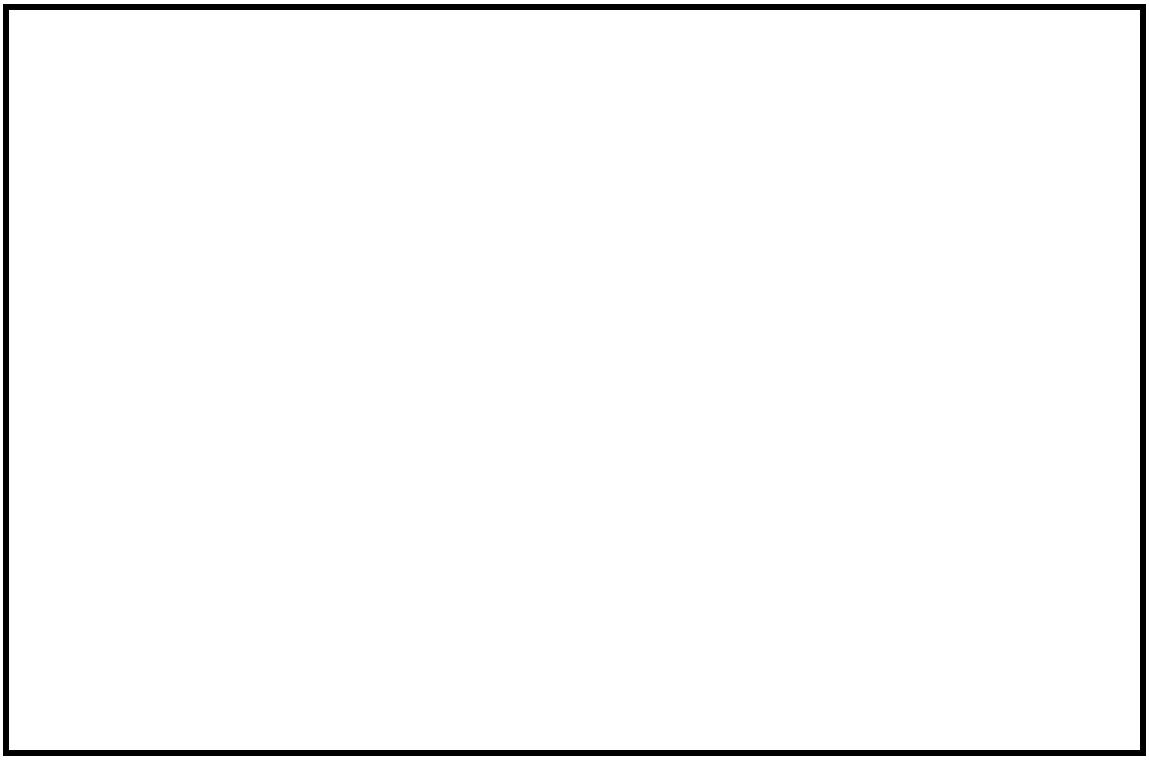

Plate 38: Old sign demarcating the limit of the emergency grazing area