ENVIRONMENTAL IMPACT ASSESSMENT OF THE POWER LINES FROM THE KUDU GAS POWER STATION (UUBVLEI SITE) TO ORANJEMOND AND OBIB RESPECTIVELY

Final

Route Evaluation and

Environmental Impact Report

Volume 1

NamPower

Prepared by:

Enviro Dynamics (Pty) Ltd
P O Box 20837
Windhoek
Namibia
Tel: 264 61 223336
Fax: 264 61 240309
E-mail:
envirod@africaonline.com.na

June 2005

ENVIRONMENTAL IMPACT REPORT

The EIA Team

The following specialists contributed to this study:

Ms Stephanie van Zyl:	Team Leader, Socio-economic issues, Public Participation, Enviro Dynamics
John Pallett	Ecology and Fauna excluding avi-fauna, EEAN
Ms Coleen Mannheimer:	Botany, individual consultant
Mr Chris van Rooyen	Ornithologist, Endangered Wildlife Trust
Dr Dieter Noli	Archaeology, individual consultant

Acknowledgements

The following people are thanked for their input to this study:

- Mr John Langford of NamPower for providing technical background, working with the team to communicate with affected parties and to find an optimum route, attending meetings, and handling the administration of the project;
- The team specialists who conducted their studies amidst a very tight schedule;
- Bob Burrel, Dawn Jones and Belinda Beukes for assisting with logistics, holding meetings and providing data;
- Jono Smith, the logistics manager of NamPower in Oranjemund, for assisting with logistics and escorting some of the specialists; and
- Dr Peter Tarr of SAIEA for his guidance and thorough review of the EIA process.

Table of Contents

List of Appendices (Volume 2)

List of Figures

List of Tables

List of Acronyms

CBD	Convention on Biological Diversity
CCGT	Combined Cycle Gas Turbine
CDM	Consolidated Diamond Mining
CSIR	CSIR Environmentek
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMF	Electromagnetic Field
EMP	Environmental Management Plan
ESKOM	Electricity Supply Commission
I&APs	Interested and Affected Parties
ICAO	International Civil Aviation Organisation
IFC	International Finance Corporation
IUCN	International Conservation of Nature Resources
KV	Kilo Watt
MET	Ministry of Environment and Tourism
Namdeb	Namdeb Diamond Mining Corporation
NAMPOWER	Namibia Power Corporation
NBC	Namibian Broadcasting Corporation
OPGW	Optical Fibre Shielding Wire
ORM	Oranjemund
ORMWP	Orange River Mouth Wetland Park
PWC	Permanent Water Commission
SAPP	Southern African Power Pool
TOR	Terms of Reference
WEC	Walmsley Environmental Consultants

1 Background

1.1 Introduction

1.1.1 The Kudu CCGT Power Station

The Kudu Gas Field was discovered in 1974 by Chevron/Regent/ SOEKOR; a further two wells drilled in 1987 and 1988 confirmed the potential of the discovery. An exploration licence was awarded to Shell in 1993 who together with Energy Africa and Texaco drilled a further four wells of which three confirmed more gas. Shell however relinquished their share in 2002 and it was taken over by Chevron Texaco (60%) and Energy Africa (40%). When Chevron Texaco decided to relinquish their share in November 2003, Energy Africa (100%) took over as Lead Developer and Operator and subsequently farmed out 10% shareholding to NAMCOR.

Oranjemund was identified as being the best position for a power plant (The locality of Oranjemund is shown on Figure 1-1 below).

Figure 1-1: Map of Namibia

It is a small diamond mining town owned by Namdeb Corporation, situated near the mouth of the Orange River in the south-western corner of Namibia. The Orange River forms the boundary between Namibia to the north and South Africa to the south.

A phased development of the Kudu gas field has been adopted as the most appropriate strategy to meet commercial viability criteria. The first phase of the Kudu Power Project will be the development of a nominal 800 MW combined cycle gas turbine (CCGT) power plant

at Oranjemund, to be commissioned in 2009. The natural gas reserves within the Kudu Gas Field are sufficient for a nominal 800 MW power plant, operating for a minimum of 22 years, without the need for additional appraisal drilling. It is anticipated that, if additional gas reserves are proven after 2-3 years of gas production, and the demand for electricity warrants it, the second phase of the project, an additional nominal 800 MW CCGT power plant, will be commissioned in 2014.

The Kudu Power Project encompasses three main developments:

- the development of the gas field, and the construction of a pipeline to the power plant and gas conditioning plant adjacent to the power plant (referred to as the upstream component);
- the construction and operation of the power plant itself; and,
- the construction of power lines from the power station to feed into the Namibian and South African power grids (referred to as the downstream component).

Separate EIA's cover the upstream development, i.e. gas field, pipeline and gas conditioning plant, and the development of the Combined Cycle Gas Turbine (CCGT) power station. The relationship between the various components of the overall Kudu gas-to-power project and their respective impacts will be documented following the completion of the separate EIA's.

1.1.2 Work done to date

As part of the objective to ensure economic, social and ecological sustainability, NamPower have considered a number of options for the siting of the power plant. The selected site to some extent dictates the routing of the power lines and gas pipeline.

Following the recommendations of a preliminary EIA completed in 1998, NamPower continued in 2004 to carry out a full EIA of Site D as a possible location for the power station. The study found it to be acceptable environmentally and socially, and the Record of Decision from the Directorate of Environmental Affairs was awarded in that same year.

In the mean time, NamPower has decided to also fully consider Uubvlei as a possible alternative site for the power station, mainly because the routing of the gas pipeline from the gas platform at sea to Site D could interfere with Namdeb's mining operations.

The EIA for the Uubvlei site is presently being completed.

Figure 1-2 shows the relative position of Site D and Uubvlei to Oranjemund.

1.1.3 The downstream component

Since a proposed 220 kV line from the Kokerboom Distribution Station, near Keetmanshoop, to the Skorpion mine follows the same route as a line between a power station at Oranjemund and the Kokerboom distribution substation, the NamPower Board, after accepting Oranjemund as the preferred location for a power station, decided to pre-invest in the Kudu Gas Project by building the power line at 400 kV instead of 220 kV. This line, except for the section between Skorpion Mine and Oranjemund, was completed in April 2002.

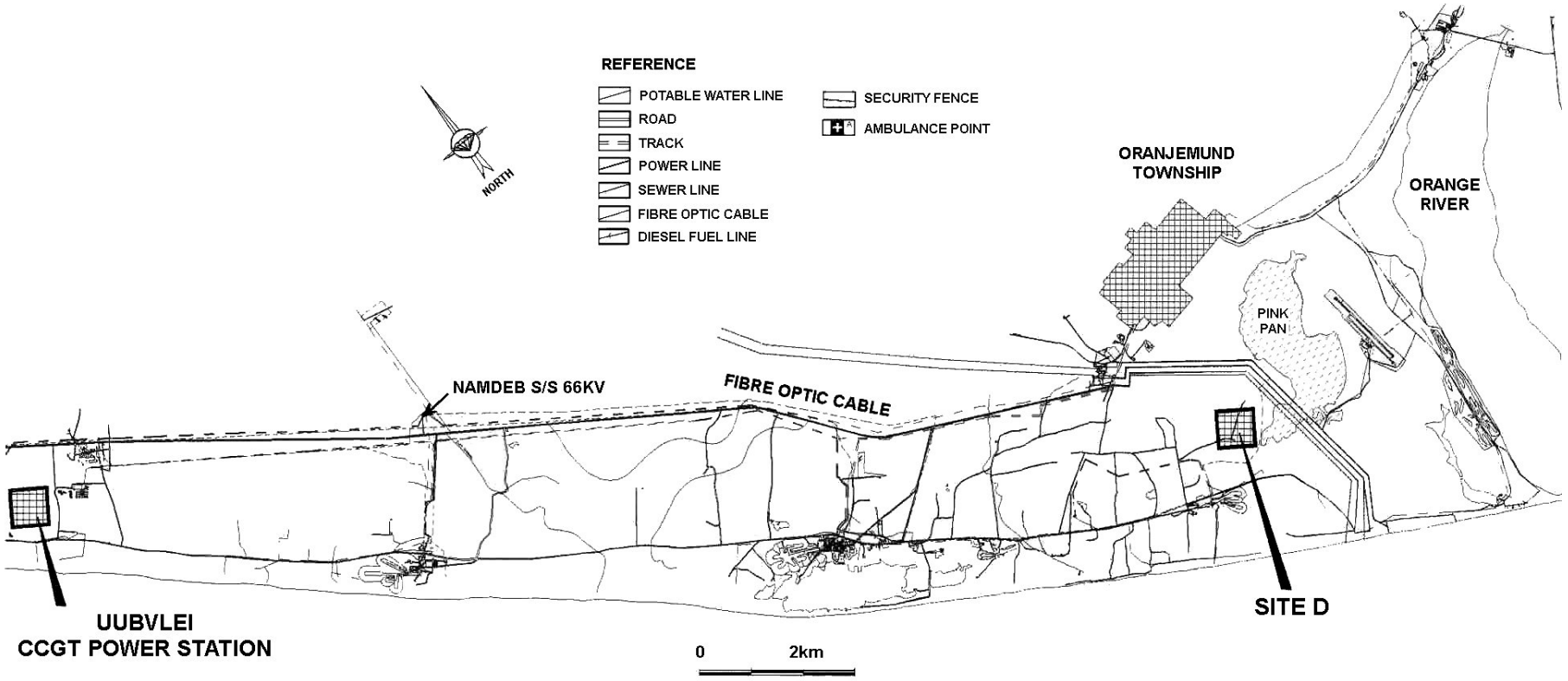


Figure 1-2: Location of Uubvlei relative to Oranjemund and Site D

NamPower needs to construct 4 parallel power lines from the Kudu Power Station development. For the first phase of the project, two 400kV lines will be needed to feed into the Namibian and South African grids respectively as well as a 220kV line to connect the power station to the South African 220kV network at Oranjemond Substation. The second phase (another 800 MW) would require an additional 400kV line to feed the South African power grid.

NamPower previously commissioned an EIA of the 400kV line from Kokerboom substation near Keetmanshoop via Skorpion mine to the Kudu gas Power Plant at Site D, as well as of the 220kV power line from the Plant to feed into the South African power grid.

A record of decision was issued by MET in 2001 in which the proposed routes of the power line were approved. In the mean time, it has been determined that two additional 400kV power lines are needed to feed into the South African grid, including the second phase of the power plant development. NamPower commissioned an update of the EIA to reflect the changed circumstances of the power lines from Site D around Oranjemund. This EIA was completed early in 2005 and a Record of Decision is presently awaited.

In addition to the EIA presently being conducted of building and operating the power station at the Uubvlei site, the environmental and social suitability of the transmission lines from that site also need to be assessed. This report therefore covers the Environmental Impact Assessment of the groups of transmission lines originating from Uubvlei to Obib and Oranjemond substations respectively.

1.2 Report layout

The layout of the report has been structured as follows:

- **Section 1**: **Background –** this present section, dealing with the subject of this EIA, the background to the project, and the Terms of Reference.
- **Section 2:** **Administrative, Legal and Policy Requirements –** all relevant requirements from applicable laws, regulations and international conventions.
- **Section 3**: **Project Proposal** – locality, and technical details of the project, as well as alternatives considered.
- **Section 4**: **Consultation** - a summary of the consultation process followed with stakeholders and interested and affected parties and the issues identified.
- **Section 5**: **The receiving environment** - a summary of the environment exposed to the project activities.
- **Section 6**: **Route evaluation and assessment**– an account of the process followed to evaluate the route alternatives, and the impacts expected along each alternative.
- **Section 7**: **Conclusions and recommendations**
- **Section 8:** **References**

This report is part of a series of three stand-alone documents as follows:

- **Volume 1:** Route Evaluation and Environmental Impact Report (this report).
- **Volume 2:** Appendices (Details of Scoping and Specialist Reports)
- **Volume 3:** Environmental Management Plan

1.3 Terms of Reference

The following are extracts from the Terms of Reference for this assignment.

"*The main aim of the EIA is to confirm the best routes for the various power lines taking into account all relevant biophysical and social components of the environment, as well as all financial and technical constraints, and then to advise on how best to construct and maintain the lines based on the above criteria…*

The consultant shall compile a data model such as a Geographic Information System (GIS)-based data model or similar to act as a decision support system for assessing the acceptability or otherwise of the preferred routes and, if applicable, identifying more acceptable routes."

In order for the consultant to fulfil the aims of the EIA, the study shall seek to:

- minimize the negative environmental impacts of the power lines and the supporting infrastructure (including construction and operational phases),
- establish a data base so that a reasonable level of confidence can be placed on the suitability of the route selected,

- consult all the interested and affected parties (or at least a representative sample) to ensure that their needs and concerns are taken into account (I&APs were identified during previous studies and the current EIA for the Kudu power plant, so the consultant will not have to develop this list from scratch).
- achieve maximum synergy with the team conducting the revised Kudu power plant EIA, and
- comply with Namibia's Environmental Assessment Policy. "

1.4 Approach to the Study

Key elements of the team's approach to the study include:

- **Scoping**: The scoping exercise, aimed at identifying issues that need to be considered, and thus the direction of the study, built on previous work done for the power station and transmission lines for Site D. The same contact list for stakeholders used in the previous studies was used. One public meeting was held in Oranjemund, as a combined participation process with the power station EIA. Windhoek stakeholders were electronically communicated with.
- **Route evaluation and assessment**: To determine the ecological and social advantages and disadvantages of the alternative routes.
- **Mitigation**: Proposed solutions to avoid or minimise the negative impacts.
- **Environmental Management Plan**: Describes how the mitigation strategy should be implemented.

The EIA builds on the earlier work described. It has been conducted in parallel with the EIA for the Uubvlei Power Station, with some activities such as the public meeting, and bio-physical and archaeological fieldwork undertaken jointly.

The Route Evaluation and Environmental Impact Report (this document), describes the first three tasks listed, while the EMP will be a separate document.

The following site-specific specialist studies were conducted to augment the information of the previous EIA's.

- Archaeological desk study and field survey;
- Botanical desk study and field survey;
- Desk study and field survey on the terrestrial fauna; and
- Ornithological desk study.

1.5 Assumptions and Limitations

The main limitations to the study were as follows:

- The first 15km from Uublvei inside the security area was only briefly assessed, due to time constraints. The specialists however do not believe that more time spent along this section will significantly change the outcome of the study.
- The last section to Obib outside the Sperrgebiet boundary could not be accessed, and was therefore not assessed on the ground. However, this area was covered during the previous EIA of the power lines from Obib substation to Site D, and the helicopter survey for this EIA. Moreover, the specialists have a working knowledge of the area.

Further constraints experienced by the individual specialists are listed in their reports attached in Volume 2.

2 Administrative, legal and policy requirements

The EIA team is required to report on the national policy, legislative framework and international conventions governing the activities of this project. The applicable ones and their implications for the project are summarised below.

2.1 Policy and legislation dealing with environmental conservation and management

- The **Constitution of the Republic of Namibia**, Article 95(1), stipulates that "The state shall actively promote and maintain the welfare of the people by adopting policies aimed at, the maintenance of ecosystems, essential ecological 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".

- **Namibia's Environmental Assessment Policy**, endorsed by Cabinet and published in 1995, stipulates that all listed programmes and projects should be subjected to a required environmental assessment procedure. Appendix B of the document containing a guiding list of activities requiring EA includes electrical transmission lines.

- The impending **Environmental Management and Assessment Act** has a similar list, which also includes '…the erection, construction or upgrading of facilities for the commercial transmission and supply of electricity with the exception of power supply line of less than 2km in length."

- The **Southern African Power Pool Region (SAPP)** has a set of guidelines for EIA of transmission lines. These guidelines have been studied and their principles considered.

- The **Labour Act of 2004** includes the **Regulations for the Health and Safety of Employees at Work.** These regulations prescribe conditions at the workplace, including construction and electrical safety.

- Section 52 of the **Diamond Act 13 of 1999** deals with Restricted Areas, requiring that approved persons must enter with a permit. Restricted Areas are declared as such by the Minister in the Government Gazette, and include areas where on- or offshore mining or related activities take place. The entire Sperrgebiet is such an area, but will soon be managed by the Ministry of Environment and Tourism when it is proclaimed as a National Park. The areas where Mining Licences are held such as Mining Area 1 at Oranjemund will still be restricted under this law.

- Civil Aviation Standards of the International Civil Organisation (ICAO) dictate that all obstructions to be erected within 8 km from an airport need to be approved by the applicable civil aviation authority. Annexure 14 of these standards is applicable to this project.

2.2 Namibia's commitment to international conventions

- In accordance with the **Convention on Biological Diversity** (CBD), to which Namibia is a signatory since 1992, the country is obliged under international law to conserve its biodiversity (Barnard ed., 1998).

- As a signatory to the **Convention to combat Desertification**, Namibia, is bound to prevent excessive land degradation that may threaten livelihoods.

- **Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention on Wetlands**), Ramsar, 1971. The Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty, which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. As waterfowl may transcend international frontiers during their seasonal migrations, the Convention recognizes that they should be regarded as an international resource.

  In terms of this convention, the Orange River Mouth is designated a Wetland of International Importance. This makes Namibia responsible for ensuring that the Government is informed at the earliest possible time if the ecological character of the Orange River Mouth wetland is likely to change as the result of technological developments, pollution or other human interference. Namibia is responsible for communicating information on such changes, without delay, to the International Union for the Conservation of Nature and Natural Resources (IUCN).

  Article 4.2 of the Convention stipulates that if Namibia, in its urgent national interest, restricts the boundaries of a wetland included in the List, it should as far as possible compensate for any loss of wetland resources, and in particular it should create additional nature reserves for waterfowl and for the protection, either in the same area or elsewhere, of an adequate portion of the original habitat.

2.3 International Finance Corporation (IFC) / World Bank Guidelines

The following environmental and social safeguards of the International Finance Corporation and the World Bank need to be considered during this EIA:

- Environmental, Health and Safety Guidelines for Electric Power Transmission and Distribution;
- Environmental Assessment (OP 4.0 of 1998);
- Safeguarding Cultural Property (OP 4.12); and
- Policy on Disclosure of Information

This EIA complies with the requirements of these guideline documents.

3 Description of the project

3.1 Project rationale

At the present time, Namibia imports more than 50% of its annual energy needs from South Africa. Rising domestic demand in South Africa and Namibia is expected to lead to a shortfall in continued supply of electricity to Namibia beyond 2007. The Kudu Power Project is one of the preferred options to address the predicted shortfall in electricity peak load demand by 2007; mid and base load capacity by 2011, and growth in power demand in the region in the short to medium term. In addition to meeting NamPower's projected demand, electricity generated by the Kudu CCGT plant will be exported to South Africa and other SADC countries to meet their own demands (CSIR, 2004).

3.2 Purpose of the proposed activity

The first phase of the Kudu Power Project will be the development of a nominal 800 MW combined cycle gas turbine (CCGT) power plant, to be commissioned in 2009. The natural gas reserves within the Kudu Gas Field are sufficient for a nominal 800 MW power plant, operating for a minimum of 22 years, without the need for additional appraisal drilling. It is anticipated that, if additional gas reserves are proven after 2-3 years of gas production, and the demand for electricity warrants it, the second phase of the project, an additional nominal 800 MW CCGT power plant, will be commissioned in 2014.

The proposed power lines will feed power from the station to the South African and Namibian grids. While one 400 kV line will be sufficient to feed the Namibian power grid, one 400 kV and one 220 kV power line will be needed to transmit the power to South Africa for the first phase of the project. A second 400 kV line will be added once the second phase of the project is realised.

3.3 Details of the Kudu CCGT Power Plant Site

A feasibility study undertaken in 1997 identified Oranjemund as being the optimum location for a power plant compared to the other options (refer to Figure 1-1, Section 1).

The Uubvlei scenario is located some 25km north of Oranjemund, at a hostel and workshop of Namdeb. The site is proposed on mined-out land. A hostel, single quarters, and a workshop of Namdeb are also located at Uubvlei. Dredge ponds lie between the proposed site and the shore. The site currently lies within a high security mining area operated by Namdeb (see Figure 1-2).

The site measures about 37 Ha (650 m x 570 m), which includes land needed for construction stage and laydown.

The possible later development of the plant to 1600 MW capacity will take place within the confines of the currently designated site. All construction activities, e.g. concrete mixing, stockpiling of materials, will be conducted on land immediately adjacent to the areas designated for the two 800 MW units. Figure 3-1shows the details of features at Uubvlei.

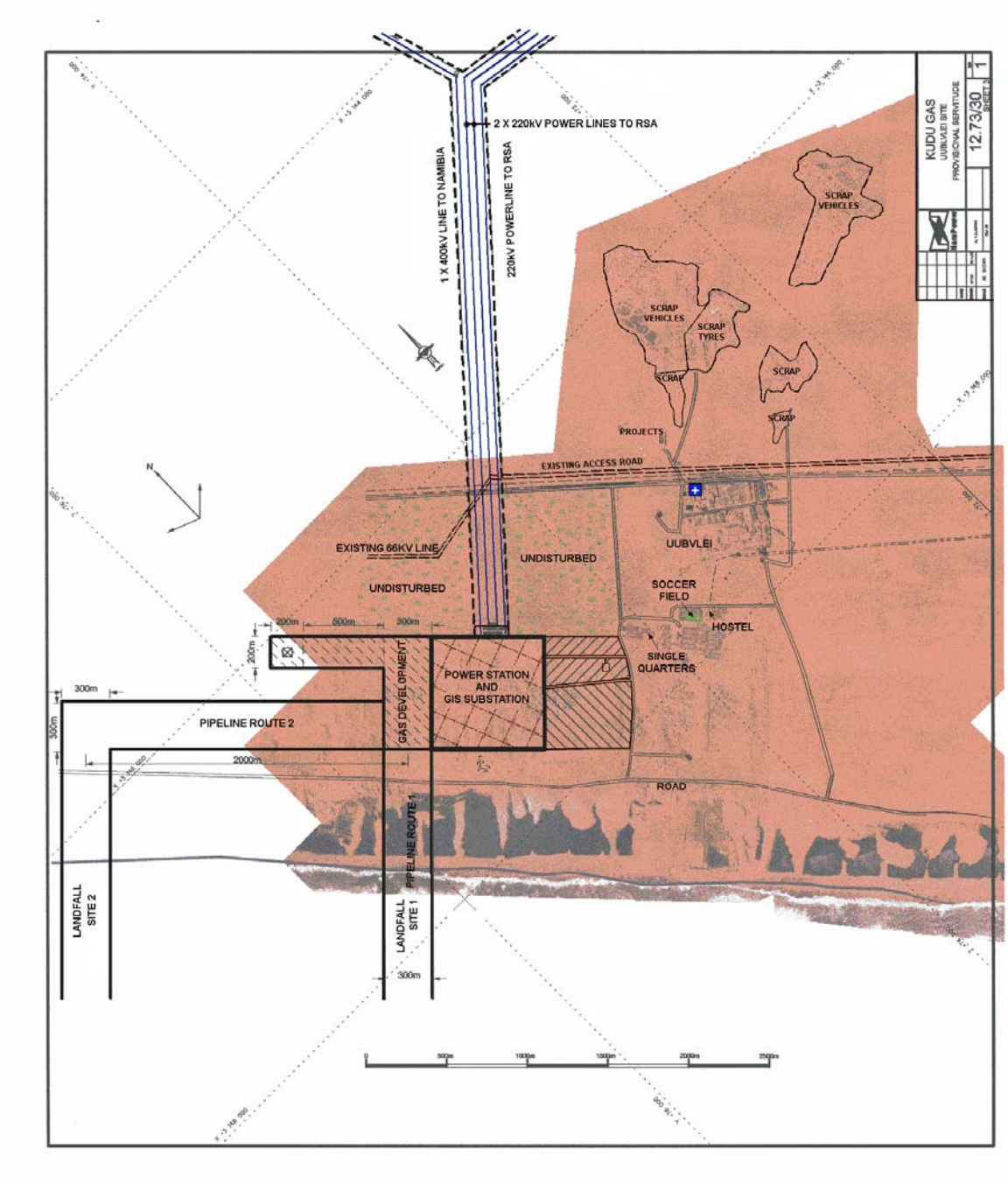


Figure 3-1 Site layout at Uubvlei (Source: NamPower)

3.4 Power line details

3.4.1 Locality of alternative routes

The proposed power lines will run from the proposed CCGT Power Plant at Uubvlei. While these lines will extend into Namibia and South Africa, this study considers their routes to the Oranjemond substation across the Orange River, and the Obib substation near Skorpion Mine respectively.

The alternative routes initially considered at the outset of the study appear on Figure 3-2.

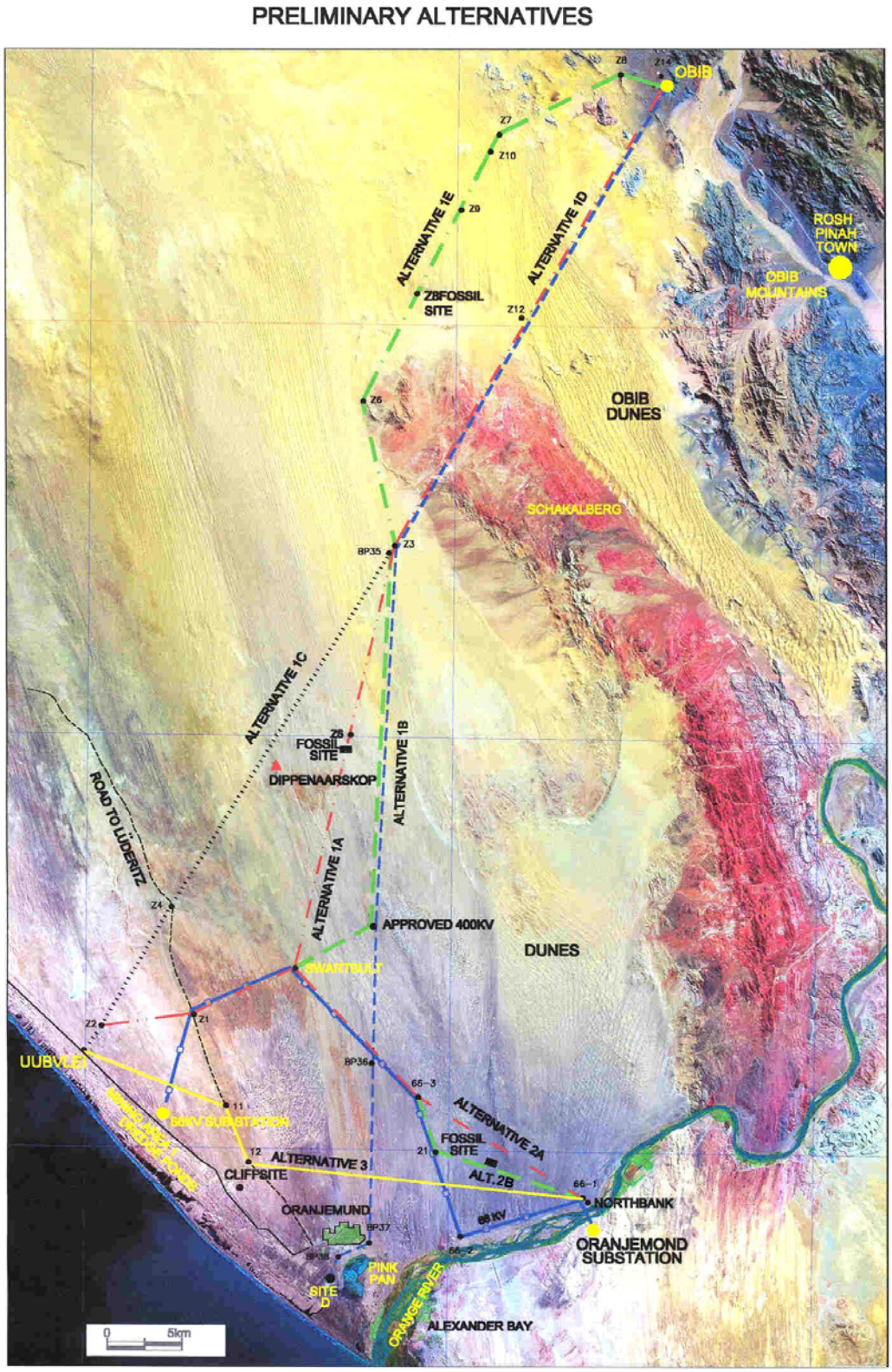


Figure 3-2: Preliminary Alternatives.

Possible route to South Africa

To enable transmission to the South Africa grid, NamPower presented two alternative routes to link Uubvlei with the Oranjemond substation. They appear as Alternatives 2 and 3 in Figure 3-2.

Alternative 2 follows the existing Namdeb 66kV power line that runs from Uubvlei to the Oranjemond substation. At bend point 66-3 this route leaves the 66kV route and turns in a south-easterly direction towards the point where the 66kV line crosses the Orange River. The reason for this deviation from the 66kV line is because the latter follows the Orange River bank, where there is not enough space to accommodate the additional transmission lines. In addition, the power line would likely not maintain a safe distance from the Alexander Bay airfield. Other advantages of avoiding the river are to avoid further visual intrusion along the Orange River Wetland Park, and the many archaeological sites found there. The low lying area inside and parallel to the river valley also poses a corrosion problem to the power lines.

Alternative 2 has a possible detour from point 66-1 via Z1 to 66-3 (Alternative 2B). These are two options around the GP Pan, so called by Namdeb to indicate a possible reserve area.

Alternative 3 has been suggested to join up with the existing Oranjemund-Lüderitz road, turning south-eastwards towards the river crossing north of Oranjemond Substation. This route is not suitable for the following reasons:

- Namdeb has advised that their power lines within the fog belt along the coast suffer considerable maintenance problems and costs because of corrosion.
- The route would fall just outside the aviation safety zones for the Oranjemund airport, and would not be ideal from an aviation safety point of view. It intersects the approach route of the Oranjemund airfield.

For these reasons, NamPower decided to discard Alternative 3 as a possible alternative.

Possible routes to Obib

Alternative 1 leaves Uubvlei along the same route as its RSA-bound leg (Alternative 2) as far as Swartbult. From there it turns directly north-eastwards towards the Schakalberg area (Alternative 1A), or follows a detour via the Obib-Site D route (Alternative 1B).

A possible short-cut for the above leg of Alternative 1 would follow from point Z2 through to Z4 via Dippenaarskop to BP 35 (Alternative 1C).

From BP 35, the original proposal, as approved for the route to Site D, was to cut across the Schakalberg straight towards Obib (Alternative 1D).

During the helicopter survey, this route was found to be unacceptable for the following reasons:

- It cuts across the Schakalberg, which hosts rare and endemic plant species and habitats, also generally known as an important area of scientific and potential tourism interest.
- The high dunes found along this section, present technical difficulties for the construction of the power lines.
- The route traverses some higher lying ridges, horizons and inselbergs. These prominent features would highlight the power lines, increasing their visibility through the area.

For these reasons, the team discarded the direct route from BP35 to Obib.

During the helicopter survey, Mr Trygve Cooper identified and proposed an alternative detour around the Schakalberg and a route that better negotiates the inselbergs near Obib substation. The detour favours lower lying areas as they would be less visible. It was also endeavoured to skirt the higher dunes, as they would complicate construction. This detour leaves BP35 to point Z6 through to Z7, Z8 and Obib (Alternative 1E).

The route alternatives that were included in the detailed study following the helicopter survey are shown on Figure 3-3. The co-ordinates of the route considered appear in Table 3-1

	Latitude in degree	Longitude in degree	Latitude in deg, min	Longitude in deg, min	Description
21	-28.500576	16.490188	S 28° 30.03'	S 16° 29.41'	
66-1	-28.527841	16.592067	S 28° 31.67'	S 16° 35.52'	
66-3	-28.467548	16.478214	S 28° 28.05'	S 16° 28.69'	
66-4	-28.391044	16.394480	S 28° 23.46'	S 16° 23.67'	
66-5	-28.420592	16.316258	S 28° 25.24'	S 16° 18.98'	
A	-27.843506	16.635323	S 27° 50.61'	S 16° 38.12'	NW corner of registered Nampower Obib Site
B	-27.842911	16.639673	S 27° 50.57'	S 16° 38.38'	NE corner of registered Nampower Obib Site
C	-27.849083	16.640741	S 27° 50.94'	S 16° 38.44'	SE corner of registered Nampower Obib Site
D	-27.849678	16.636392	S 27° 50.98'	S 16° 38.18'	SW corner of registered Nampower Obib Site
BP01	-27.846770	16.637583	S 27° 50.81'	S 16° 38.25'	Terminal Angle Strain (Line entrance at Obib)
BP02	-27.847845	16.636310	S 27° 50.87'	S 16° 38.18'	Angle Strain
BP03	-27.850226	16.618957	S 27° 51.01'	S 16° 37.14'	Angle Strain
Z8	-27.846183	16.609500	S 27° 50.77'	S 16° 36.57'	
BP35	-28.137000	16.453667	S 28° 08.22'	S 16° 27.22'	
CLIFFSITE	-28.523649	16.355446	S 28° 31.42'	S 16° 21.33'	
DIPPENAARSKOP	-28.267713	16.378917	S 28° 16.06'	S 16° 22.74'	
EXISTING400KV	-28.367029	16.447315	S 28° 22.02'	S 16° 26.84'	From Swartbult directly onto existing
					400kV EIA route
NORTHBANK	-28.530100	16.594800	S 28° 31.81'	S 16° 35.69'	
ORANJEMOND	-28.547309	16.599325	S 28° 32.84'	S 16° 35.96'	
S-BULT	-28.397961	16.366828	S 28° 23.88'	S 16° 22.01'	
SWARTBULT	-28.389850	16.392505	S 28° 23.39'	S 16° 23.55'	
UUBVLEI	-28.441333	16.248000	S 28° 26.48'	S 16° 14.88'	
Z1	-28.418833	16.323250	S 28° 25.13'	S 16° 19.40'	
Z2	-28.426317	16.259933	S 28° 25.58'	S 16° 15.60'	
Z3	-28.132400	16.458117	S 28° 07.94'	S 16° 27.49'	
Z4	-28.353617	16.307267	S 28° 21.22'	S 16° 18.44'	
Z5	-28.248700	16.428383	S 28° 14.92'	S 16° 25.70'	
Z6	-28.045567	16.435433	S 28° 02.73'	S 16° 26.13'	
Z7	-27.882917	16.526750	S 27° 52.98'	S 16° 31.61'	
Z8FOSSIL	-27.980517	16.472017	S 27° 58.83'	S 16° 28.32'	
Z9	-27.929017	16.501117	S 27° 55.74'	S 16° 30.07'	
Z10	-27.893350	16.520883	S 27° 53.60'	S 16° 31.25'	

Table 3-1: Co-ordinates of the routes investigated during the EIA

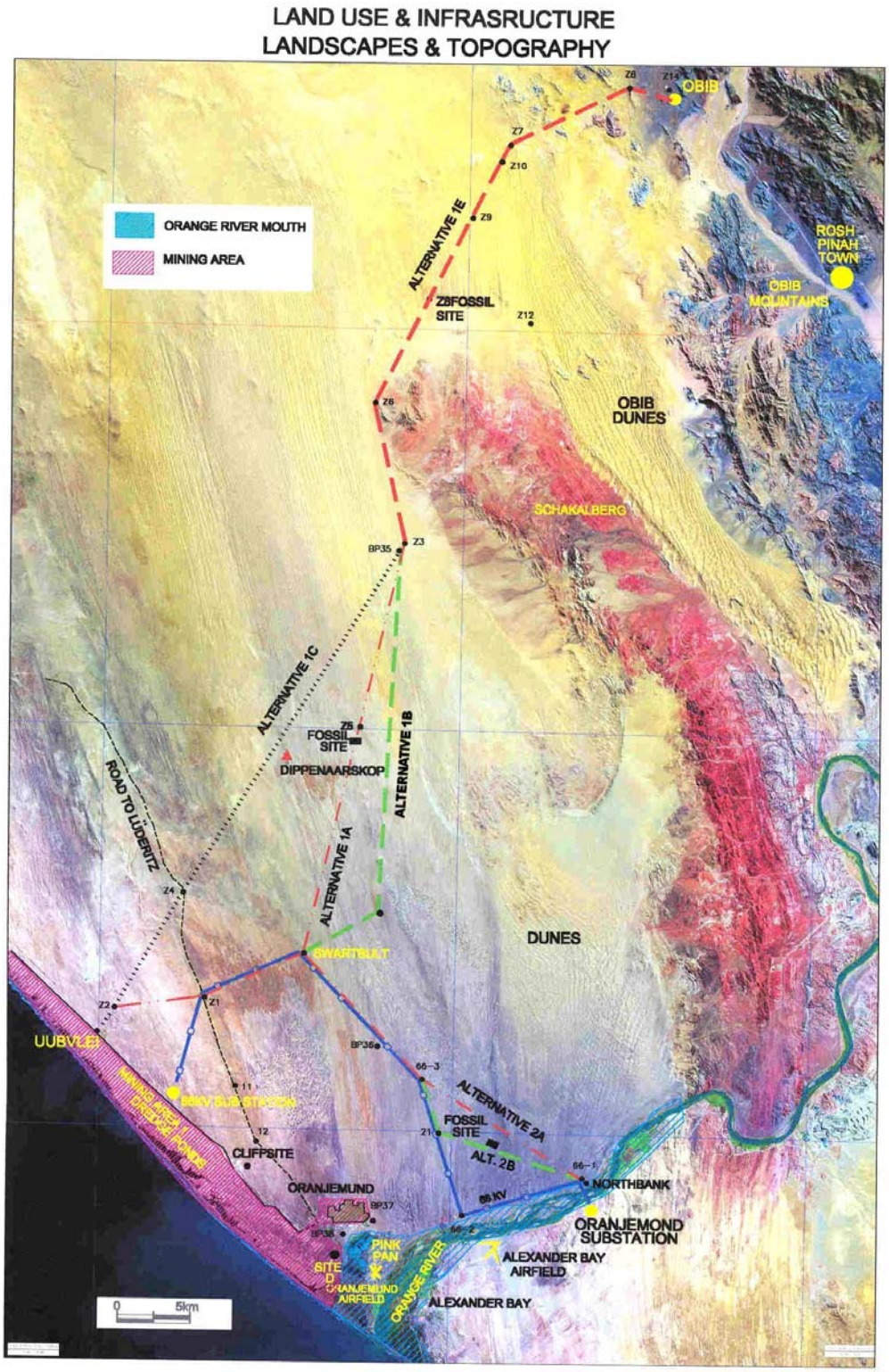


Figure 3-3: Alternative routes considered during the EIA

3.4.2 Power line designs

The conductors will be supported on two different types of pylon: a Self-supporting Suspension and Strain Tower, which is 26,6 m high, as may be seen in Figure 3-4 and a Compact Cross Rope Suspension Tower, 37,3m high, as shown in Figure 3-5. The former design will be used on bends, while the latter type will be used mostly on straight sections. The 35m high towers will be spaced 400m to 500 m apart. The Compact Cross Rope suspension Tower is environmentally friendlier because the delta configuration reduces the chances of birds being electrocuted. The structures also contain far less steel and utilise less space for foundations.

Figure 3-4: Strain tower

Figure 3-5: Compact Cross Rope Suspension Tower

The line will further have the following characteristics:

- Quad tern conductor
- Silicon composite rubber insulators
- Optical fibre shielding wire (OPGW)
- Corrosion protection measures

3.4.3 Corridor widths

The corridor would make up a strip of land under and surrounding the power lines within which no other development would be allowed. The only vegetation removed in these corridors would be for access tracks and for the pylon foundations. Given the contractors do not cause unnecessary damage, plant and animal life under the power lines can thus continue as before.

The corridor width needed to accommodate the individual power lines is 40 m for the 220kV line and 55m for the 400kV line. The route running from the Kudu Gas Power Station will eventually have three 400kV and one 220kV power line running parallel to each other, and will thus need a total corridor width of 205m. The route running northwards into the Namibian power grid will accommodate only one 400kV power line, and will thus have a corridor width of 55m. The route running to South Africa will have two 400 kV and one 220kV power line, calculating to a corridor width of 150m.

3.4.4 Construction activities

It will take an estimated 1,5 years to build the power lines from Uubvlei to Oranjemond and Obib substations respectively. If the Kudu Power Station is to be operational by 2009, then construction of the power lines, or those needed for the 1st phase of the project, that is the 400kV to Namibia, and the 220kV and 400kV lines to South Africa, would have to commence by no later than 2007.

All the components for the power line construction (steel pylons, conductors, insulators, etc.) will be transported to site by road on low-bed trailers. According to Nampower (pers. Comm., Langford), materials and equipment will be transported from Alexander Bay and Rosh Pinah. No significant impacts are expected on these roads.

Contractors' sites of approximately 200mx300m are normally made along power line routes. For the entire Kokerboom-Skorpion-Kudu Gas route, 6 to 7 such sites were estimated. However, because of the wilderness qualities of the project area, and the need to cause as little damage as possible, the EMP for the project states that construction camps will only be allowed at Rosh Pinah and Oranjemund from where access will be allowed along the power line route only.

The consultant doubts the practicality of this requirement. Tracks will be considerably more if the area needs to be accessed daily. It is therefore rather proposed that the contractor be allowed to make two camps at accessible, yet environmentally less sensitive locations.

The construction team will have to travel from Oranjemund and Rosh Pinah to the power line route and camps by way of existing roads if they are sufficiently direct, or else new temporary access roads will have to be constructed along the power line route. Once on the route, the construction team will travel only along the route access road. All the components will be transported to the power line route by road using low-bed trailers where possible.

The foundations of the pylons will be concrete blocks above ground.

Bush clearing will not be necessary in this area where vegetation cover is very low, except where access roads are needed. Usually only vegetation that grows above 4m is pruned.

The steel towers will be erected on site either by using a crane to place the pre-assembled tower onto the concrete foundation or by building up the tower from its concrete foundation section by section. Concrete will be mixed and poured on site, thus all the concrete constituents (crushed stone, cement, water and sand) will also have to be transported to site each day. The conductors will be strung using heavy-duty mechanical winches. Anchors will be drilled into bedrock or screwed in sandy areas. Guy ropes will be fixed from the anchors to the towers.

3.4.5 Maintenance activities

Once a power line has been built it requires very little maintenance. Obvious accidents such as lightning strikes or towers blown over by exceptionally strong winds will be repaired by using the access roads under the line or by helicopter. Routine inspections of the lines are carried out from the air, thereby reducing the need for a permanent access road to almost zero.

3.4.6 Natural material and human resources required

A very small component of this project requires materials from the surrounding natural environment. Unlike other infrastructure projects such as roads, relatively limited amounts of sand and water will be needed for the concrete foundations of the pylons. All other materials will be imported, pre-fabricated components.

NamPower intends calling for tenders from electrical contractors with the relevant experience to construct the power line according to specifications. Since the construction of the line and the substation is of such a technical and skilled nature, there will be limited scope for the recruitment of unskilled labour from the area. Local labour can be used for digging the foundation trenches, and for bush clearing of the pylon areas and access roads. This represents a mere 1% or less of the total construction costs. No recruitment is to take place at Oranjemund to avoid job seekers flocking to the town. Workforce accommodation would ideally be in the nearby towns or at Uubvlei, although this would create accessibility problems while construction progresses in the centre of the area. Accommodation could therefore move, as construction progresses, depending on sequence of the route. The principle should be that the closest camp (only 2 camps should be allowed at environmentally less sensitive locations), town or hostel is always used for accommodation. This issue will be described in detail in the EMP of the project.

3.4.7 Waste materials

Relatively little waste is generated during power line construction activities. Spoil will be generated from the foundation trenches, and there is likely to be some cement, gravel, sand, left over cable, etc, remaining after construction. Apart from the construction waste, normal household waste such as plastic bags, tins, bottles, paper, etc. will be generated. Waste generation is an obvious impact on all projects, but it is how waste is minimised, re-used, stored, transported, and disposed of that determines whether this part of the project's ecological footprint would be acceptable. A section will be dedicated to this aspect in the EMP.

4 Project Alternatives

4.1 Introduction

The need for the power lines and consideration to alternatives to and within the project is linked to the Kudu Gas CCGT Plant. The pertinent links are the following:

- The site for the CCGT Plant determines the source of the power line routes.
- If the Kudu CCGT Plant were built, there would be no other alternative, but to construct the required power lines for the South African and Namibian power grids.

This section therefore briefly summarises:

- Location alternatives (different towns/regions);
- Site Alternatives for the power station
- Overhead vs. underground cables

Figure 4-1: Site Alternatives for the CCGT Power Plant at Oranjemund (Source: NamPower)

- The no project alternative

The alternative power line routes considered are discussed and evaluated in Section 6.

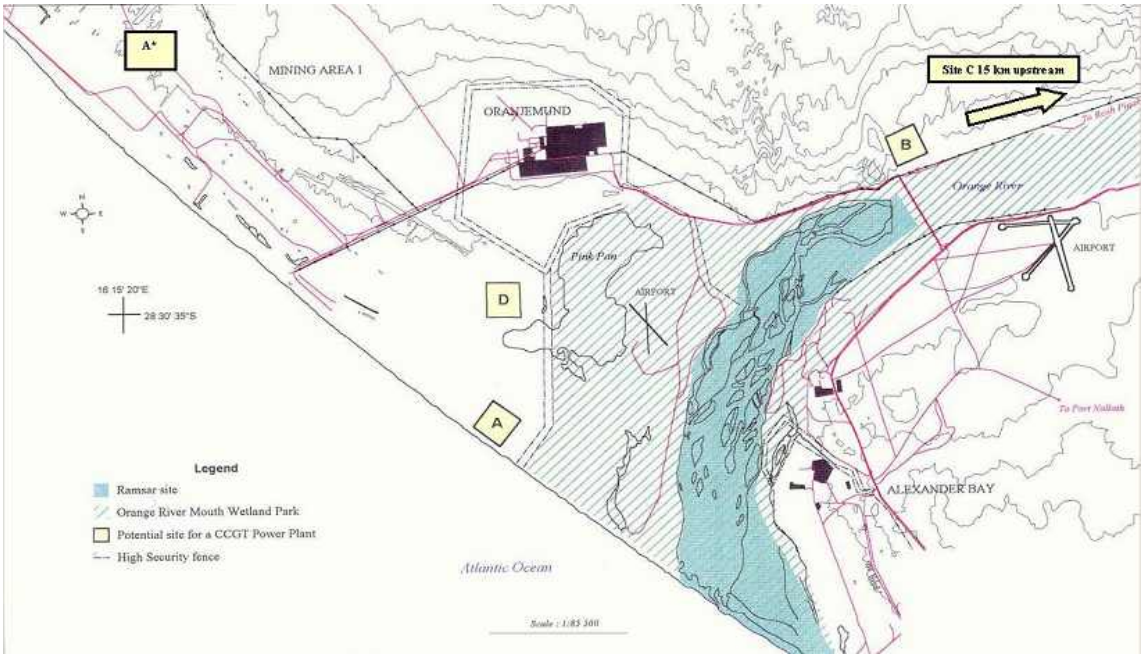
4.2 Kudu Power Plant Location Alternatives

4.2.1 Regional location

Seven regional location alternatives were considered in a 1997 feasibility study for a CCGT plant in Namibia, all of which are deemed to be technically and environmentally viable. Three sites were at Lüderitz, three at Oranjemund, and one at Keetmanshoop (NamPower, undated).

4.2.2 Oranjemund sites

Four sites in the Oranjemund area were evaluated during the extensive lead up period to this EIA; these have been examined by Nampower (NamPower, undated). Three of the sites were evaluated in a Preliminary Environmental Assessment conducted by Walmsley Environmental Consultants in 1998.



Site D was one of the three sites included in the Preliminary Environmental Assessment (Walmsley Environmental Consultants, 1998). Based on their evaluation and consultation with Namdeb, NamPower made a decision that Site D is the preferred alternative and should be the principal alternative considered in the recently completed EIA performed by CSIR Environmentek (2004), stating that Site D performed best against the evaluation criteria suggested (NamPower, undated, cited in CSIR, 2004). Site D was found to be an environmentally and socially acceptable site for the CCGT power station.

Site D is still an option, which NamPower could use for the construction of the site, should financial, technical, and logistical issues and interactions with Namdeb so dictate. A route has been recommended for the construction of the power lines from Site D that would cause the least social and ecological interference in the area. This route is shown on Figure 4-2, Alternative 2.

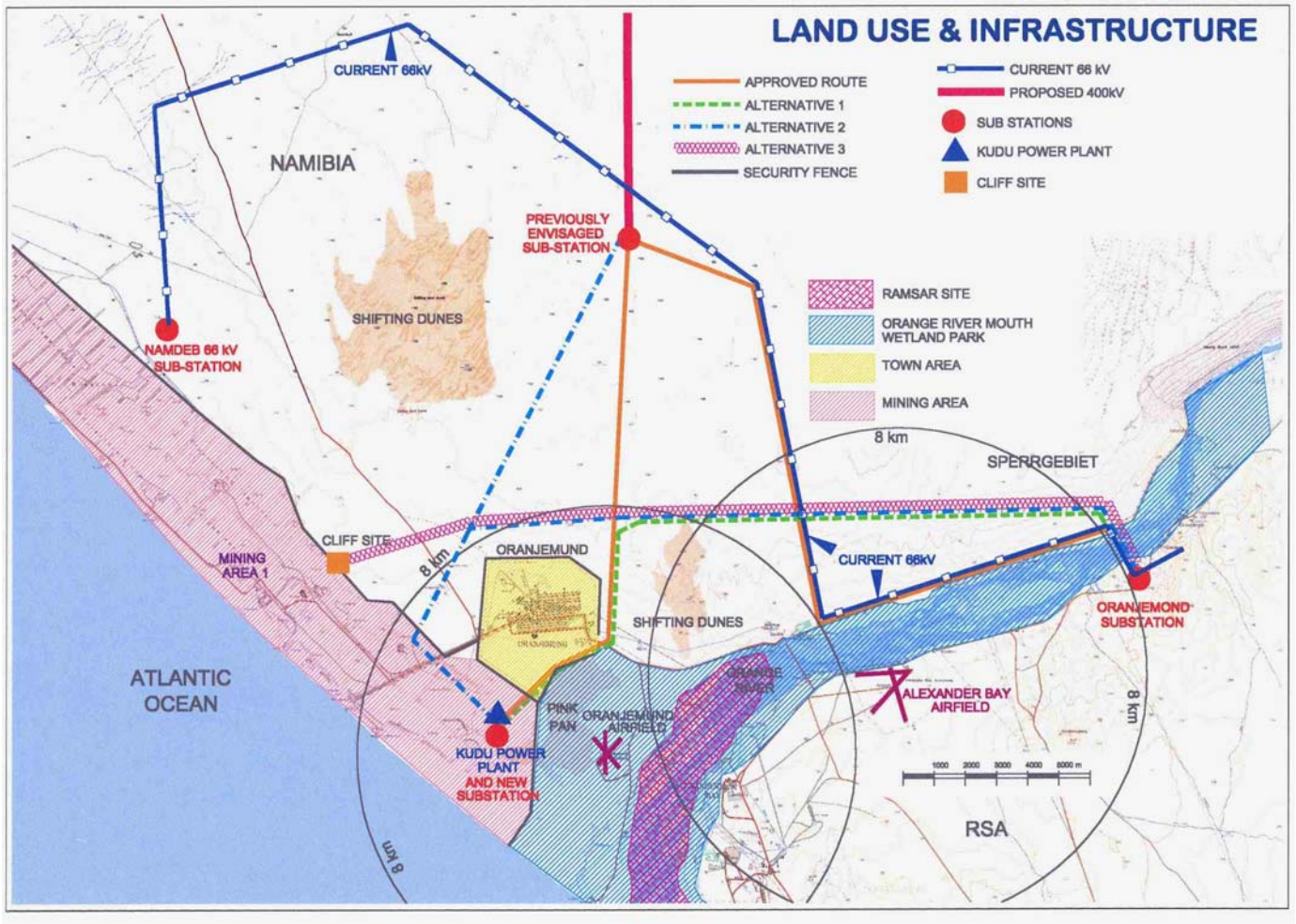


Figure 4-2: Power line routes considered for the Site D scenario

4.3 Summary of alternative projects

CSIR (2004) summarises the alternatives considered to the Kudu Gas Field Project. Ultimately, a combination of large- and small-scale hydropower, natural gas and possibly wind energy will be used to diversify Namibia's energy mix, with a future demand and supply scenario for Namibia illustrated in Figure 4-3 below. The option of regional energy supply has not been studied by Nampower, but this is being initiated at SADC level. However, the option of regional mega-project will in all probability not materialise in the short term.

Generation and transmission initiatives identified with potential to contribute in the next five to ten years are the following:

- The CCGT plant based on Kudu gas (earliest commissioning date 2009);
- A Lower Kunene hydropower plant, potentially at Baynes (earliest commissioning date 2014);
- Small-scale hydropower schemes on the Orange River (up to 12 plants each with a 6 MW capacity - earliest commissioning date for the first plant around 2006);
- The Popa Falls hydropower plant on the Okavango River (earliest commissioning date 2009); and
- A coal fired power station at Walvis Bay.

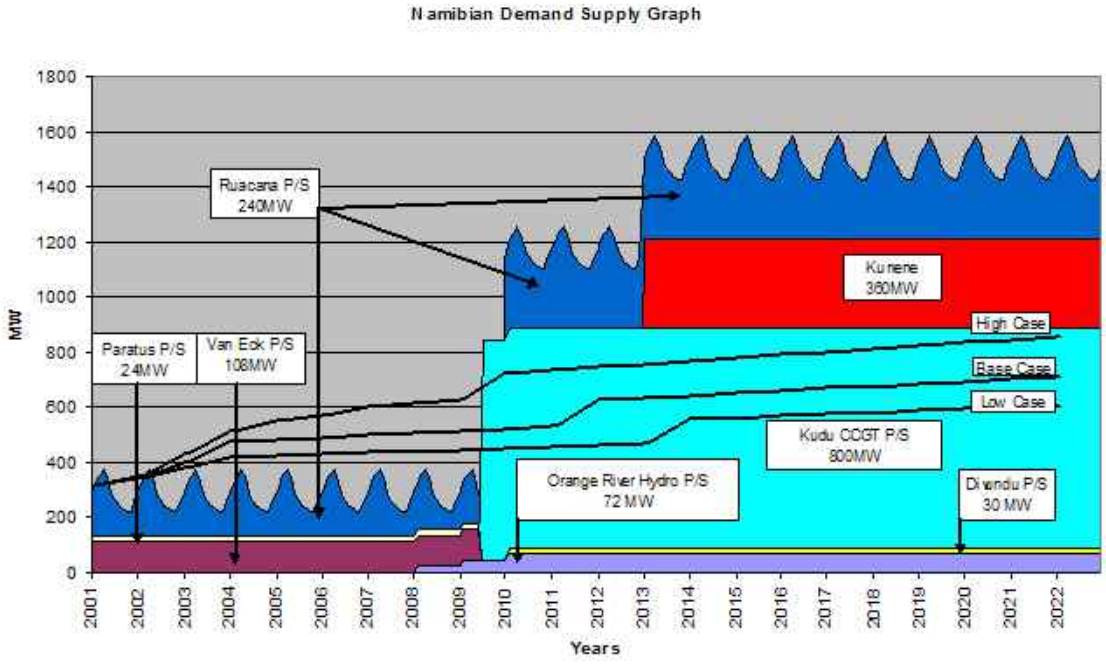


Figure 4-3: Namibia Supply and Demand Graph (Source: NamPower)

As adapted from CSIR (2004), major reasons for elimination of or consideration to the various alternatives are given in Table 4-1 below.

Alternative	Major reason for consideration as an alternative
Activity Alternatives	
Increase importation of energy from South Africa	Importation agreement with Eskom due to expire in 2006; terms of subsequent agreements likely to be different and more costly.
Natural gas in Namibia	Being considered in the present EIA.
Additional hydropower from the Kunene River	Lag time to bring electricity production on line (commissioning date 2014)
Wind energy from various sites	Costs prohibitive without international donor funding and/or carbon offset benefits. Non-firm energy, i.e. will need a backup source to generate electricity when the wind is not blowing.
Natural gas from other Southern African countries, e.g., Angola	Angolan gas fields are not yet operational and would require ship-based transport; other regional sources will not be available in the short term
Location alternatives	
Keetmanshoop (Site A)	Decreased plant performance due to altitude and lack of an adequate cooling water source
Lüderitz (Sites A, B and C)	Increased construction costs associated with distance from gas source
Oranjemund Site A*	Problems with regard to access to the mining area
Oranjemund Site B	Cooling water from Orange River not reliable
Oranjemund Site C	Situated in moving dunes area. Long gas pipe line
Oranjemund Site D	Location alternative that was subject to an EIA, and that was found to be environmentally and socially suitable, subject to prescribed mitigation measures

Table 4-1: Summary table of alternatives considered (Source: CSIR, 2004)

4.4 Overhead vs. underground cable

It is not surprising that people normally ask at public meetings if the power lines could run underground instead of overhead. Overhead power lines could destroy an area's "sense of place" and simply look ugly. In the case of this project, there would eventually be two new corridors with large power lines running through the desert.

The technology needed for underground cabling is some six times more expensive than for overhead cabling, ruling out this option as a viable solution (Langford, pers. comm.). In addition, trenches would have to be dug for laying the four different conductor sets, thereby resulting in significantly more damage to the vegetation, soil structure and habitat.

For the reasons mentioned above, underground conductors have been ruled out as an option for the proposed transmission lines.

4.5 No-project alternative

Power generated at the Kudu CCGT Plant cannot be sold to and used by its potential customers if the transmission lines are not constructed. The opportunity to develop and trade with the natural capital of the country and to diversify its economy would be lost if the project does not continue. Namibia would have to continue relying heavily on energy sources imported from abroad at a high cost to meet the growth in the energy demand. The opportunity to transfer knowledge and skills to Namibians and to diversify income-generating sources for Oranjemund would also be lost.

5 Stakeholder Consultation and Scoping

5.1 Consultation approach

This study has built on the scoping and consultation conducted in the previous EIA's for the power lines and the Kudu CCGT Power Plant at Site D. Issues raised in the previous studies were noted and shared with interested and affected parties, so that they could add to or amend the list.

The following activities were undertaken to facilitate stakeholder and community engagement during this EIA process:

- The EIA for the power station at Uubvlei and for the power lines running from it started at the same time. This presented an opportunity to combine stakeholder and community participation efforts. Most consultation activities for the two EIA's were therefore combined, taking care to channel identified issues to the various team leaders.

- A planning and information meeting was held with Namdeb staff on 15 and 16 March 2005, during which potential challenges affecting Namdeb were highlighted, and information required from Namdeb listed.

- A helicopter survey was undertaken to probe the nature of the terrain at a first glance. Mr Trygve Cooper, the Chief Ranger for the Sperrgebiet with the Ministry of Environment and Tourism joined the team to advise on the best route alternatives (See his letter of confirmation in this regard, Appendix 1A).

- The I&AP lists for the EIA's of the power station and associated power lines originating from Site D were used. The main stakeholder and community group in this case is the Oranjemund community and Namdeb (See Appendix 1B containing the I&AP list).

- A Background Information Document was compiled, which was distributed during the consultation process (See Appendix 1C).

- Windhoek stakeholders were invited via e-mail to comment on the proposed project.

- A public meeting was arranged and held in Oranjemund on Thursday 31 March 2005. The invitation to the meeting was sent via e-mail to the mine-wide distribution service of Namdeb. Local businesses, the Regional Council, the Mine Workers Union of Namibia and other non-Namdeb organisations were also sent the invitation. At the meeting, people initially complained that they had received the invitation on short notice, even though it was sent to the mine-wide distribution some 2 weeks before the meeting. NamPower extended its willingness to hold another meeting if the audience so decided. However, after some deliberation, the meeting concluded that another meeting was not likely to generate much more interest or raise any more issues. Apart from the meeting, people had the opportunity to communicate their input via e-mail (all Namdeb staff and other key organisations in Oranjemund have access to e-mail). The Regional Councillor for the area was consulted about the matter after the meeting, and

he stated that another meeting would be superfluous. The minutes of the public meeting appear in Appendix 1A.

- The NBC and the press were sent the Background Information Document.
- NamPower placed all documents and notices about the study on their website.
- The Draft Route Evaluation and Environmental Impact Report, with its appendices containing the specialist reports was made available to the public and stakeholders for review. The review period was from 17 May 2005 to 7 June 2005. Notices to invite comment were placed in the local press, and sent via e-mail to the entire stakeholders' list and the mine-wide e-mail service at Namdeb. Copies of the Draft Report were made available in the Windhoek National Library, the NamPower library in Windhoek, and the Namdeb and National Libraries in Oranjemund. The documents were also placed on the NamPower website. Copies of the Draft Reports were also provided to the members of the Inter-Ministerial Review Group.
- No written comments on the draft document were received. A prominent member of the Oranjemund community who as instrumental in organising a petition for the proposed power station and associated power lines at Site D, called the author to confirm that the Oranjemund community seems positive about the document and its proposals.

5.2 Key issues and concerns

The list below provides a summary of the key issues raised during the scoping process. The list shows how each issue has been incorporated into the study, with a reference of where in this document further details surrounding each aspect may be found.

ISSUE	COMMENT/HOW ADDRESSED
Priority Issues	
Impacts on fauna and flora	Specialists visited all the alternative routes to establish existing fauna and flora and how they would be affected (see Sections 6.7, 6.8, 7.3.4, and 7.3.5)
Aesthetics/Visual Impact	Consider the locality in the Sperrgebiet, impact on wilderness qualities and tourism (See 7.3.2).
Impacts on the paeleontological and archaeological record	The Sperrgebiet is rich in interesting and scientifically valuable fossil records and archaeological material. Any potential development needs to consider the impact on these resources. A specialist studied this issue in detail (see 7.3.6).

Diamond reserves lock-up	There are potential diamond reserves in the paeleo channel of the Orange River. The power lines potentially cross these areas. Although partly a commercial issue between Namdeb and NamPower, it could influence the routing of the power lines. (See 7.3.1).
Other Issues	
Shifting sand dunes and other topographical features	The extent to which sand dunes are traversed influences the technical feasibility of a power line. Sand scouring, difficult founding conditions and access during construction and operation all go hand in hand with high and shifting sand dunes (See 6.4 and 6.5)
Bird issues	Increased nesting opportunities for crows, bird collisions and electrocutions need to be considered. The pylon designs selected pose no risk for electrocutions. The power lines will be away from the flight paths between the Pink Pan, Orange River Mouth and the coastal dredge ponds. Previous observations made for the Orange River crossing are still applicable. (See 7.3.3)
Access and security	NamPower and Namdeb will discuss and jointly resolve the issue of access into the mining area.
Aviation safety	This issue is almost completely resolved if the power lines originate from Uubvlei. Power lines should cross the Orange River in one corridor to limit visual intrusion. Power lines should generally be placed in one corridor as far as possible.
Corrosion	The closer to the coast the power lines will be, the more important this issue becomes. Corrosion protection measures will be needed during operation and maintenance (See 6.3.4)
Construction cost	Consider the construction cost of the various alternatives.
Waste management	Waste is generated in any project, but it is how much waste is generated, and how it is used, re-used, collected, stored, disposed of and transported that influences the sustainability of the project. Sound waste management will enjoy a dedicated section in the Environmental Management Plan.
Decommissioning	What will happen to the power lines once they are redundant? This aspect needs to be addressed in the EMP, which will be a separate document.

Accommodation during construction Spread of HIV/AIDS	See Section 3.4.4 The potential spread of AIDS as a result of the social interaction of the workforce with each other and the Oranjemund community needs to be addressed by including an awareness programme to this effect in the Environmental Management Plan.

Table 5-1: Issues identified and how they have been addressed during this study

6 The receiving environment

6.1 Introduction

Environmental data are relatively scarce for the study area. Unfortunately Namdeb data only covers certain parts of Mining Area 1. Maps of the area are in short supply or not readily available, presumably because of its high security status.

This limitation has to a large extent been overcome by consulting previous studies, including the previous power line EIA's (WEC, 1998 and 1999), the recent EIA of the Kudu CCGT project at Site D (CSIR, 2004), and the EIA of the power lines originating from Site D (Enviro Dynamics, 2005) for relevant data.

Specialists were tasked with verifying the relevance of and adding to these data by conducting a field surveys. More detailed methodological statements are given in each of the specialist reports.

The key elements of the receiving environment are summarised below. They are described in further detail in the specialist studies annexed to this document (Appendices 2 to 5).

6.2 The socio-economic environment

6.2.1 Community and stakeholder concerns

Specialists and local residents raised the following socio-economic issues:

- In view of the ecological importance of the area, its tourism potential, and the attempt to diversify land use in the town and region, the power lines should take into account future development scenarios, specifically increased tourism, and reduction in access control to the area.
- Some members of the Oranjemund community feel that the visual effect of the power lines should be considered, particularly in view of potential tourism.
- The power lines originating from Uubvlei would be far more favourable from an aviation safety point of view, than those from Site D. Nevertheless, the power lines should follow one corridor as far as possible, and cross the Orange River at the same point as the existing 66kV line.
- Accommodation of construction workers should be considered.

6.2.2 Methodology and data sources

The most updated socio-economic information was collated for the Kudu CCGT EIA (CSIR, 2004 and from the previous transmission EIA's (WEC, 1998, and Enviro Dynamics, 2005). Existing 1:50 000 topographical maps and satellite images were used to highlight key features. Apart from a site visit made to inspect the existing facilities at Uubvlei, further socio-economic fieldwork was not deemed necessary.

6.2.3 Description

Regional Socio-Economic Setting

Oranjemund is an isolated and closed mining town situated in the south-western corner of Namibia at the mouth of the Orange River. See Figure 1-1. The nearest towns are the diamond mining settlement of Alexander Bay on the South African side of the Orange River and the mining town Rosh Pinah, some 75km to the north-east. Oranjemund falls within Diamond Area 1 which extends along the coast in a roughly 3km band from the Orange River mouth to Chaemaeis Bay south of Lüderitz. According to the 2001 Housing and Population Census, Oranjemund has a population of 4451.

Oranjemund falls within the Karas Region, with the regional government located in Keetmanshoop. Settlement is largely confined to widely scattered small towns. The harsh climate limits agricultural potential, so that mining is the region's biggest employer.

Land Ownership

Diamond Area 1 or "The Sperrgebiet" is off limits to all but Diamond Mining Companies that have held prospecting rights for this land for over 80 years. At present, the land falls under the jurisdiction of the Ministry of Mines and Energy. The assets in Oranjemund are owned by Namdeb Diamond Corporation (Pty) Ltd and the land is owned by the State.

When the Sperrgebiet is proclaimed as a National Park[1], the Ministry of Environment and Tourism will control the land outside the diamond concession areas. Figure 6-1 shows that the proposed routes fall within Mining Area 1 as they leave Uubvlei. Once they have crossed the existing security fence just east of Uubvlei, they traverse the Sperrgebiet towards Obib and the Orange River respectively.

Land Use

The westernmost part of the routes as they leave Uubvlei run across land disturbed in some areas by mining activities. The route to South Africa would run parallel to an existing 66kV power line. Apart from these features, the routes cross undisturbed land presently not utilised for any particular activity. . See Figure 6-1 showing the land use of the area.

There are potential diamond reserves remaining along some sections of the routes, particularly north of the Orange River in its old channel. More details on this matter follow in Paragraph 7.3.1.

[1] The Namibian Cabinet resolved that the Sperrgebiet should be proclaimed a National Park in April 2004; the actual proclamation is expected to realise in the foreseeable future.

The Sperrgebiet Land Use Plan

Following the formation of Namdeb in 1994, the exclusive prospecting and mining licence previously held by CDM in the non-diamondiferous areas was relinquished. In addition, the present mining licences held by Namdeb will probably expire around the year 2020. In view of interest in the area for a variety of uses, and the fact that present mining activity will not indefinitely sustain the area and its people, the Government in consultation with Namdeb and NGOs agreed that before the area could be opened up, a land use plan should be formulated to guide sustainable development in the area (WEC, 2001).

The Sperrgebiet Land Use Plan was subsequently compiled by Walmsley Environmental Consultants and was endorsed by Cabinet in the first quarter of 2004 (pers. Comm. Kolberg, 2004). Proclamation of the Sperrgebiet as a National Park and implementation of the Land Use Plan is awaited.

The plan describes land use zones for the Sperrgebiet. Tourism is a major component of the Plan, as this economic activity, if properly managed, is seen as an opportunity to provide income without destroying the area's biodiversity and sense of place.

The Orange River Mouth Wetlands and the Orange River Mouth Wetland Park (ORMWP)

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. The Southern and Northern banks of the River have been listed under this convention by the South African and Namibian Governments respectively. The two sites cover the last 9,5 km of the Orange River mouth.

As stated previously, both the Namibian and South African Governments therefore have a commitment to maintain the integrity of the Ramsar site and 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 to 35 km upstream. The ORMWP has been proclaimed as such. The extent of the Ramsar site and the ORMWP is shown on Figure 6-1.

The proposed power line routes would run through the following zones of the Sperrgebiet Land Use Plan:

- **Managed Resource Protected Area (mining).** These areas are 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. Once mining ceases and the areas are rehabilitated, the zoning classification could be upgraded. This zone covers the western half of the study area to just west of Schakalberg where diamond deposits may still be mined in future.
- **Wilderness Area**. Low Usage, core area where no or minimal mechanised access is allowed. The southern tip of this zone is crossed just north of Schakalberg
- **National Park**. The north easternmost part of the route, to be managed mainly for conservation and eco-tourism with a slightly greater public usage, but still controlled and limited access. Allows for vehicle access and wilderness camps, but no

permanent structures. Minor upgrading of tracks and development of hiking trails expected.

- **Strict Nature Reserve**. Areas where specific knowledge is patchy, which are worthy to be set aside for scientific study until their environmental importance has been clarified. This zone covers the Schakalberg, which is avoided by the proposed route.

The zones described above are shown on Figure 6-2.

Tourism potential

It is envisaged that the Sperrgebiet will act as a magnet for tourism in the south in much the same way that Etosha has done for the north. Not only do these parks create significant incomes in their own rights, but the surrounding areas have also benefited significantly from their presence (WEC, 2001).

The development of Oranjemund as a tourism node within this broader conservation area hinges on strategic decisions taken about its future (open up or 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, etc. According to the Sperrgebiet Land Use Plan, it is possible that Oranjemund would only become a tourist development node after the current mining areas are de-proclaimed, some time after 2020.

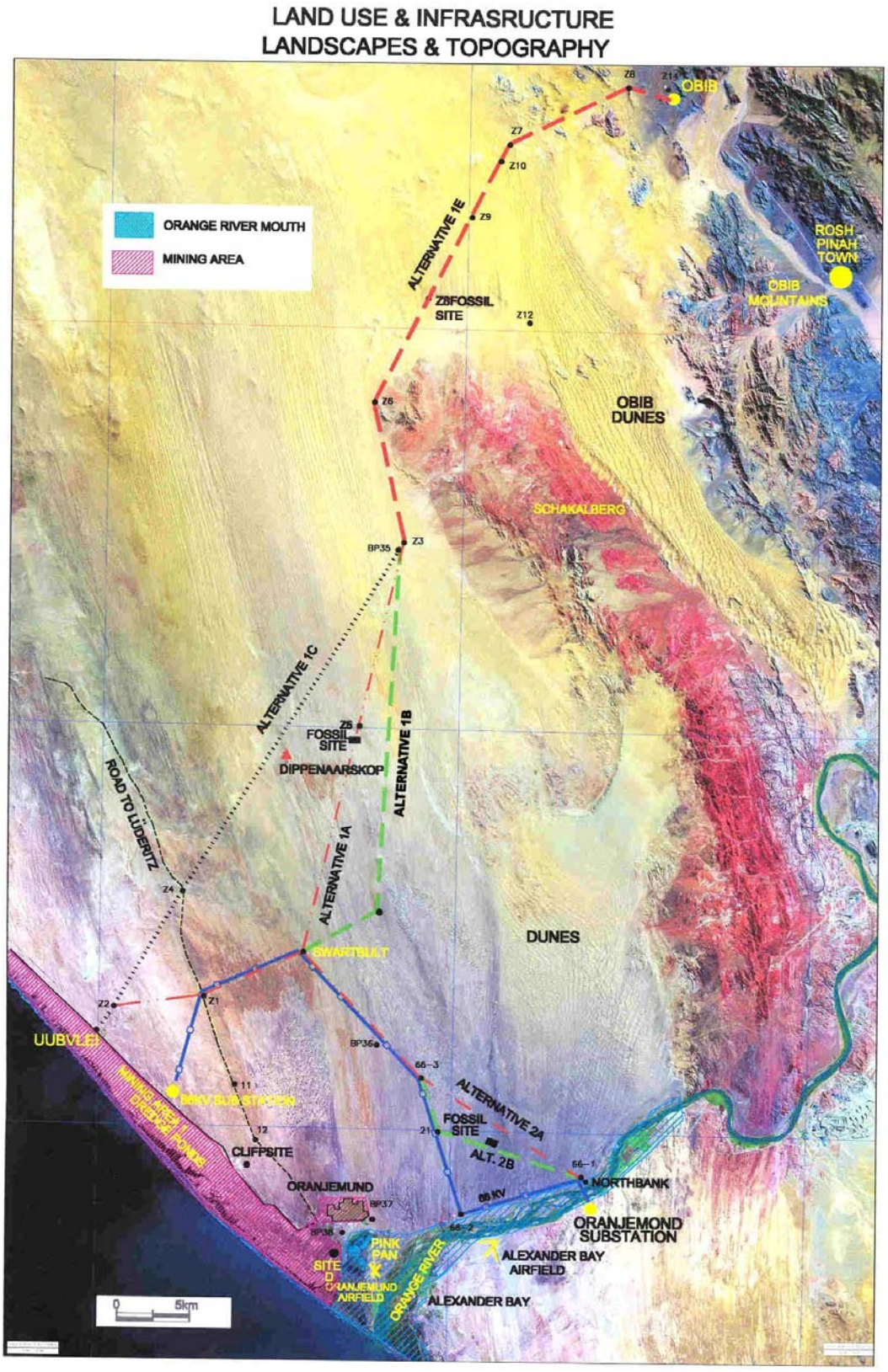


Figure 6-1: Land Use, Infrastructure, landscape and topography of the study area

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. These are mostly based on the river and the Ramsar site at the river mouth and include hotels, lodges, bird tours, sundowner cruises, golf, yachting, fish farm, mine museum, etc.

Away from the river, the landscape between Oranjemund, Uubvlei and towards Shakalberg are somewhat uneventful, and limited tourism opportunities including 4x4 trails on disturbed ground, camel safaris, etc. would be possible.

From Skorpion the landscapes towards the Obib Mountains and further towards Schakalberg present extraordinary wilderness qualities and associated opportunities for eco-tourism activities.

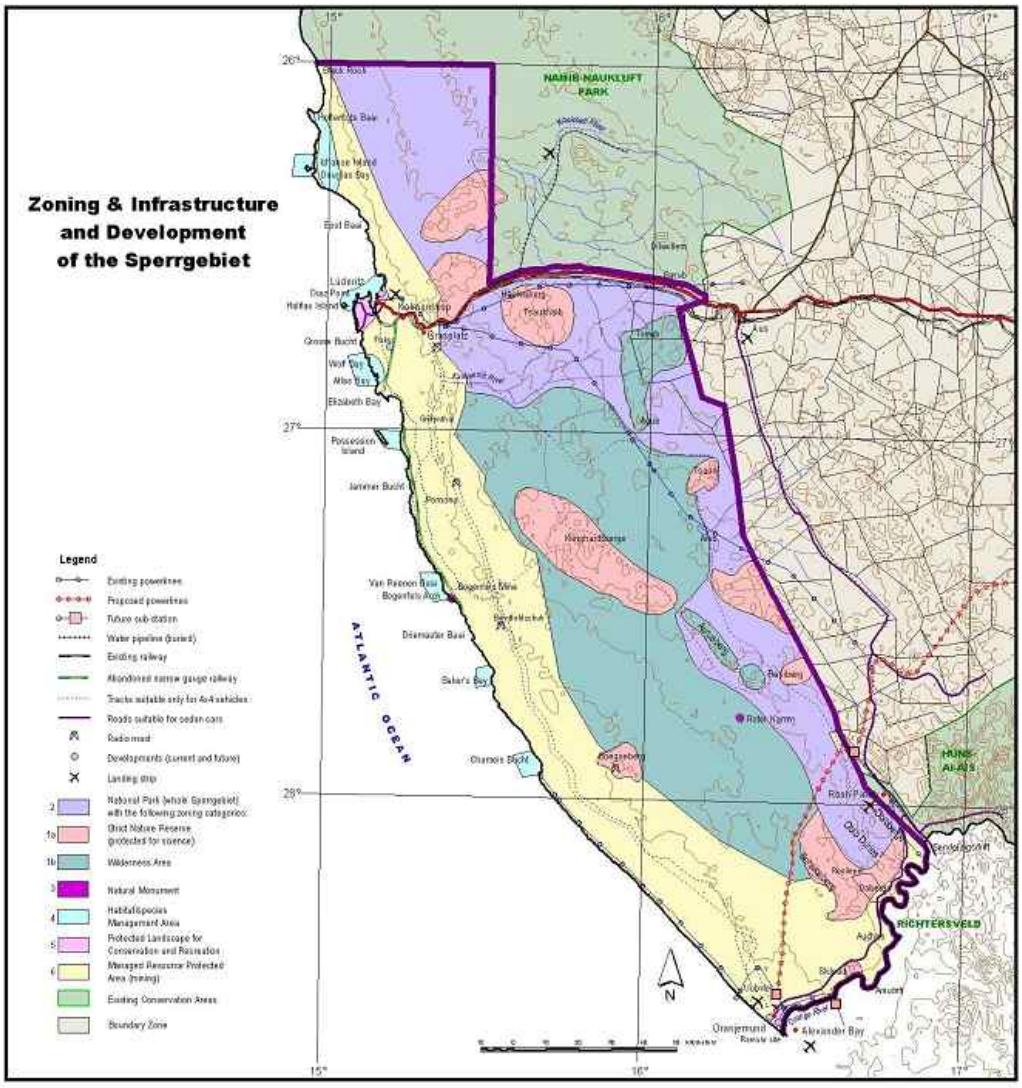


Figure 6-2: Future Land Use and Infrastructure in the Sperrgebiet. The proposed power line route shown has been approved by the Ministry of Environment and Tourism upon an EIA that was conducted in 1998. (Source: Sperrgebiet Land Use Plan)

6.2.4 Existing infrastructure

Figure 6-1 shows the infrastructural elements of the study area. They are as follows.

- A 66kV line that originates at Oranjemond substation across the Orange River, supplies power to Oranjemund and Namdeb as well as to Rosh Pinah. This line runs parallel to the Rosh Pinah-Oranjemund Road and turns in a northwesterly direction at Swartkop to the Namdeb substation. NamPower intends routing part of the new power lines along this existing corridor.
- The locality of Oranjemund and Rosh Pinah, which are both mining towns, shown on Figure 6-1.
- The Oranjemund airport lies south-east of the Pink Pan. There is also an airport at Alexander Bay across the Orange River. Air traffic is often hampered by fog.
- The existing mining area of Namdeb with its existing operations confined inside the fence is shown on Figure 6-1. The power lines running from Uubvlei traverse this area.
- The road between Oranjemund and Rosh Pinah is apparently to be upgraded to a tarred road. Telecom cables run parallel to this road.
- The route crosses the existing road from Oranjemund to Chaemaeis Bay south of Lüderitz.
- Uubvlei currently has a hostel and single quarters complex constructed and owned by Namdeb. Namdeb is in the process of relocating its workforce from there to alternative accommodation in Oranjemund. The entire complex could be an option for accommodating the Uubvlei power station construction workforce and possibly also the construction workforce for the power lines.

6.2.5 Implications and criteria for route planning

In determining the final route for the line the following socio-economic criteria and issues should be considered:

- The power lines should be routed to avoid valuable scenic resources.
- The power lines should be routed as far away as possible from the existing and potential tourist attractions, including the Orange River Mouth Wetland Park, and the Obib Mountains. Where these areas cannot be avoided, routes should follow lower lying land, and existing infrastructure corridors.
- Where the route runs through Mining Area 1, the minerals rights holders, Namdeb will have to be involved to secure access for the contractors and maintenance personnel. Mutual agreements will have to be reached as far as access and work in this area is concerned.
- Permission for the contractors to enter the area will also have to be obtained from the Diamond Branch of the Namibian Police once Namdeb has given authorisation.
- Since the entire Sperrgebiet will soon reside under the jurisdiction of the Ministry of Environment and Tourism, this authority has to be involved in the route planning and construction phase. As mentioned earlier, Mr Trygve Cooper, the Chief Ranger for the Sperrgebiet, of the MET, was involved in selecting the proposed routes. He should remain involved as the routes are refined and particularly when construction commences.
- Nampower should liaise with the Ministry of Works, Transport and Communication for requirements for road crossings, particularly in view of the potential upgrading of the Oranjemund-Rosh Pinah road.

- The selected power line route alternatives lie outside the 8km radius from the Oranjemund, and Alexander Bay airfields, implying that the Ministry of Works, Transport and Communication does not need to give its approval for the proposed obstacles near these airfields as they would be within applicable aviation safety standards.
- The power lines will also pass the existing Skorpion airfield. There is an outcrop between the airfield and the power line route, which forms a higher obstruction for approaching aircraft than the pylons beyond the outcrop. The proposed route near Skorpion will therefore be acceptable from an aviation safety point of view. A letter received from the Civil Aviation authority confirming their acceptance in this regard appears in Appendix 1A.
- To improve aviation safety at the Orange River, the power lines should be lined up with existing obstacles particularly the existing 66kv line. The Orange River crossing is an important area from a civil aviation safety point of view. At this point all power line crossings should be aligned.
- The workforce of the power lines could be accommodated in the existing Uubvlei hostel complex, or alternatively the contractor would have to make an arrangement in Oranjemund or Rosh Pinah, or move the workforce around depending on the progress with construction.

6.3 Climate

6.3.1 Stakeholder and community concerns

Issues concerning climate expressed during scoping include:

- Potential corrosion, salt build-up from sea spray and sandblasting.
- Visibility of the power lines for approaching aircraft in foggy conditions.

6.3.2 Data sources

Alexander Bay weather station records are noted in secondary sources, including WEC, 1998, CSIR, 2004, and Pallett, 1995.

6.3.3 Description

The climate of the Oranjemund area is mostly windy, and often cold and wet as a result of its proximity to the strong winds of the South Atlantic anticyclonic system and the associated cold upwelling of the Benguella current.

Average temperatures in Alexander Bay are mild throughout the year with slightly cooler temperatures in winter. The average daily maximum temperature in summer is 23.5°C with extremes exceeding 40°C. In winter the average maximum temperature is 20.8°C with extremes in the region of 35°C.

Average temperatures at Rosh Pinah near the eastern end of the project area are somewhat higher. The maximum monthly daily temperatures vary from 30-35°C in October to April and 21- 25 °C in May to September. (WSP Walmsley, 1998)

Low stratus and stratocumulus clouds are often formed during the early morning hours when onshore breezes blow over the upwelling zone. The amount of cloud cover is thus highest at night but decreases consistently from 08h00 through midday to 20h00 (CSIR, 2004).

Fog occurs, on average, on more than 100 days per year at Oranjemund, mostly from February to April. It forms as moist cold air from the ocean and meets the hot dry air of the desert. The Orange River valley serves as a pathway for the fog to penetrate as far inland as Skilpad. The fog supplies fauna and flora with much of their water requirements.

Oranjemund and the lower reaches of the Orange River are situated in the winter rainfall area of southern Africa. The annual average rainfall at Alexander Bay is 51mm over the recorded period of 53 years, most of which falls between May and August (WEC, 1998). At Rosh Pinah, this figure is slightly higher at 68.7 mm per annum.

Southerly sea breezes occur during most of the year. They are usually strongest during the afternoons. The strong southerly winds are responsible for extensive sand movement and scouring of bedrock topography. Strong north-easterly winds prevail in winter, known as “east” or “berg” winds, which may blow for a few days at a time, and cause very dusty conditions. They are associated with very high temperatures.

In the Skorpion vicinity, strong south-easterly and south-westerly winds prevail throughout the year (data from the Skorpion weather station, as reflected in WSP W, 1998).

6.3.4 Implications and criteria for route planning

Climatic factors provide clues to the ecological functioning of an area. They may pose technical constraints or challenges as far as maintenance is concerned, and influence visibility of structures.

These include the following:

- The high summer temperatures and dusty and windy conditions complicate working conditions.
- The low rainfall increases the sensitivity of the ecology to disturbance.
- High wind velocity and direction influence the stability of the pylons, and sand build-up and scour at the base of pylons.
- The regular occurrence of fog reduces the visibility of the pylons and conductors for birds and aircraft. Fog is the agent causing high corrosion and pollution of pylons, insulators and other structures. The foggy conditions reduce their lifespan and increase construction and maintenance costs.
- Structures near the coast line are subject to the highly saline salt spray. This increases corrosion and maintenance.

6.4 Topography

6.4.1 Community and stakeholder concerns

The public meeting and liaison with stakeholders revealed the following:

- Shifting sand dunes will technically be challenging terrain for the power lines
- The power lines should follow valleys and lower slopes in areas of high relief. The lines should be placed away from view along tourist routes.
- The Orange River is a major flight path for birds and crossings over it should be avoided.

6.4.2 Data sources and methodology

Topography described in the 220kV and 400kV EIA's (WEC, 1998) is generally adequate for the purpose of this EIA, and the relevant data has not changed since then. This data has been augmented with observations made during field visits.

6.4.3 Description

The topography of Oranjemund and surroundings towards Uubvlei and the centre of the study area consist mainly of slightly undulating sandy plains. The Orange River valley is the most prominent feature and drains the entire study area. Deep mobile sand also referred to as shifting sand dunes occur in various areas along the routes (see Figure 6-1). Because they pose difficulties for construction, the routes have been aligned to avoid dunes where possible. A few smaller adjustments to optimise this goal may still need to be made.

The Orange River valley is fairly wide through most of this area but the river banks become progressively steeper towards where the power line is to cross the river. The Orange River is about 750 to 800m wide at this point and the steeper southern bank rises about 60m to the Oranjemond Substation.

The eastern part of the area is more interesting visually, and inselbergs including Schakalberg and the Obib Mountains occur there. These have red dunes around their bases, and lighter coloured ones further towards the valley floors. These slopes, their associated valleys and contrasting dunes are the cause of the area's spectacular vistas.

6.4.4 Implications and criteria for route planning

- The routes should avoid the shifting or high sand dune belts
- The routes should avoid elevated slopes as they increase visibility.
- The inselbergs are interesting from a scientific perspective, hosting plants and animal species of conservation concern. They also offer attractive vistas and should therefore be avoided.
- The Orange River as a major flight path, both for birds and aircraft should be considered. The best mitigatory action would be to align the power lines in one corridor at the river crossing. Appropriate bird markers should be considered in the EIA of the proposed routes on the South African side.

6.5 Geology and soils

6.5.1 Community and stakeholder concerns

- During liaison meetings, Namdeb staff indicated that the power line routes might lock up diamondiferous reserves.
- The founding conditions for the pylons should ideally be bedrock or very stable soil conditions.

6.5.2 Methodology and data sources

Relevant information in the Environmental Evaluation of the 220 and 400 kV power lines to Oranjemond (WEC, 1998), the geological description in Pallett (1995) and the 1:50000 topographical maps are adequate to describe geology and soils. Information on potential diamond reserves was obtained from Namdeb.

6.5.3 Description

Geology

Highly deformed volcano sedimentary rocks of the Gariep group underlie the study area. They were formed during a period of ocean formation, destruction, and subsequent mountain building. The resultant material is intensely deformed sedimentary and associated volcanic rocks.

The Rosh Pinah formation in the Obib substation surrounds is formed of basal conglomerates, thin volcanic rocks overlain by quarzites, carbonates, cherts, schists, and amphibolites. The rocky outcrops, inselbergs and mountains in the Rosh Pinah area comprise these rocks, and have been sheared, faulted and tilted over time. Both the Rosh Pinah Zinc Corporation and the Skorpion Zinc ore bodies are found in the rocks of the Rosh Pinah Formation. (WSP Walmsley, 2001).

In the Oranjemund area and along the banks of the Orange River, these rocks are unconformably overlain by sediments of the Cainozoic age (Pallett, 1995). Most sand dunes are semi-stabilised. At a few locations, moving sand dunes occur. See Figure 6-1. Dunes trend in a north-easterly direction with the prevailing dynamic wind patterns.

Changes in sea level over the past 3 million years have resulted in the formation of marine terraces north of the Orange River Mouth and river terraces along the lower reaches of the Orange River (Pallett, 1995). Namdeb mines diamond deposits hosted in the marine terraces and paeleo-channels of the Orange River.

Soils

The soils of the study area are mainly poorly formed, immature desert soils as a result of the extremely arid climate, low rainfall, and high intensity winds (Pallett, 1995). The soils are subject to high salinisation, aggravated by high evaporation levels.

The soils in the region are generally not suitable for irrigated agriculture. The scarcity of water and arid climate further limit agricultural potential.

The Sperrgebiet Land Use Plan (undated) indicates a few small pockets of land along the Orange River that are suitable for high value crops. They are approximately 40 km upstream from Oranjemund and are therefore not affected by this project.

Palaeontology

The Sperrgebiet has a particularly impressive fossil record, dating from the Cretaceous period, about 58 million years ago. Some extremely rich fossil sites have been found along the Orange River and in paeleo-channels (old meander channels) (WEC, 1998). Three sites where the fossil records are exposed at the surface have been found along the routes (See Figure 6-1).

Implications and criteria for route planning

- Shifting sand dunes should be avoided as they will complicate construction access and activities.
- The mineral rights in the Oranjemund area are held by Namdeb. Therefore Namdeb should be given the option to exercise its rights to extract the minerals before the power lines are constructed.
- Very little is known about the palaeontology of the study area, but the sedimentary rocks over which the power line will pass do contain fossils. At certain locations along the route, these fossil records have been exposed along the ridges. They should be protected during construction.
- The soils most likely to be suitable for irrigation agriculture are situated in the flood plains of the Orange River, and there are none of these areas along the proposed routes.

6.6 Hydrology and the wetland system

6.6.1 Stakeholder and community concerns

The proposed power line routes being far removed from the Orange River, except at the river crossing, no particular issues with regard to the river and its wetland system were raised during scoping. However, the reader should take note of the general importance of this area and its ecological value. This underlines the importance of good housekeeping and pollution prevention during construction. The dynamics of the river hydrology need to be understood for the construction at the river crossing.

6.6.2 Data sources

The hydrology of the area is described by means of existing knowledge of the area, and published literature as referenced.

6.6.3 Description

Surface runoff drains towards the Orange River. Therefore, any pollutants and waste not properly taken care of during construction may eventually reach the river. This river forms the border between South Africa and Namibia and meets the Atlantic Ocean some 7km south of Oranjemund.

The Orange River Mouth is an internationally recognised wetland system with a unique ecology. It is a delta, with a multiple channel system between sand banks, a tidal basin and a salt marsh on the south bank (CSIR, 2004).

The Orange River is a very important perennial fresh water source to both South Africa and Namibia. Many migrant bird species favour its variety of wetland habitats in an otherwise hostile environment. In 1991 and 1995, South Africa and Namibia respectively designated the section of river west of the Oppenheimer Bridge to the List of Wetlands of International Importance under the Ramsar Convention.

A feature of the Orange River is its periodic, massive floods. Major floods occur every 8-10 years on average, but upstream regulation has resulted in fewer smaller floods. The most recent flood was in 1988, and the discharge was the largest since 1921 when systematic flow recording began (Swart *et al*, 1990, quoted in CSIR, 2004). The water quality in the river is generally good, but there are indications that the water quality is becoming increasingly saline due to high evaporation and irrigation return flows.

Water level data at the Oppenheimer Bridge are only available for the period November 1994 to February 1996. These show that in this period water levels only once exceeded 1,5m reaching 3,5 m (WEC, 1998). The 1998 flood reached much higher levels than these data, when parts of the golf course were flooded (pers. Comm., Anderson, 2004).

Oranjemund obtains its domestic water supply from ground water in an old paeleo-channel of the Orange River just upstream of the town. The coastal zone is underlain by both saline and fresh water shallow aquifers. The former is recharged constantly by the sea and the latter by the river, especially when the river is in high flow.

6.6.4 Implications and criteria for route evaluation

- Construction activities near the Orange River wetland system could indirectly contribute to its increasing silt load and other pollutants.
- Construction activities should be carefully managed to avoid unnecessary damage to vegetation cover, which could in return cause wash-away and increased pollution of the river.
- The power line and its associated activities may only slightly affect ground and surface water quality or quantity. This issue is not considered a key one for this study, but should be addressed as a standard item in the Environmental Management Plan.
- At the Orange River crossing, pylons should be placed above the high water mark, which is estimated to be at approximately 10m above the normal flow level (WEC, 1998).

6.7 Vegetation

The full vegetation specialist contribution to this study is attached as Appendix 4.

6.7.1 Stakeholder and community concerns

- The power line should avoid impacting upon protected plant species.
- Unnecessary damage to vegetation should be avoided during construction in order to maintain the integrity of the habitat.

6.7.2 Methodology and data sources

Botanical input included a review of previous vegetation studies (Giess 1971; Williamson 1997; Burke 1998, 1999) and species and area conservation status reports.

A field survey of the proposed routes was undertaken during March 2004. The routes were driven in order to assess habitats and plant species occurrence. The various habitats, as well as dominant species and species of conservation concern, were photographed for documentation purposes.

6.7.3 Description

The greater area concerned falls into the northern section of the Succulent Karoo Biome, which is regarded as a global biodiversity hotspot. It is thus important in global, as well as national, terms, especially also due to its largely pristine nature as a result of protection for the diamond mining industry over several decades. It falls within the Desert and Succulent Steppe as defined by Giess (1971). Winter and summer rains are possible, with rainfall averaging 51 mm per annum, increasing eastwards, and coastal fog playing an important role in the moisture regime of many organisms. Due to oceanic influences temperatures are moderate compared with much of Namibia, with mean daily temperature approximately 22°C. Winds, which are often very strong, occur throughout the year, mainly from the south-west, although warm north-easterly winds occur sporadically during winter. Terrestrial habitats that could be affected by the proposed development include coastal hummocks and plains, dunes, sandy plains, and several rocky outcrops near the Obib substation.

Five broad zones were defined (A – E), based on overall habitat type and dominant species present (See Figure 6-5). Each was assigned a conservation rating of 1 (least sensitive) to 5 (highly sensitive). A summarised description of each of the zones follows.

Zone A: Coastal plains and stabilised hummocks:

This area, which stretches from the Uubvlei site within Mining Area 1 as far as Swartbult, is composed of a patchwork of coastal gravely-sandy plains and stabilised hummocky areas. Along the short-cut to Obib via Dippenaarskop, there are far larger hummocks, and the vegetation is far denser. Less diverse areas of sandy hummocks dominated by grass species intervene occasionally towards the western sections near the Uubvlei site.

The vegetation is dominated by low-growing succulents. Species composition varies slightly from area to area. The vegetation in this zone, including the section east of the Uubvlei site in Mining Area 1, is largely undisturbed. The assemblage of species is typical of the coastal plains, which include stabilised hummocky areas. Most of the plant species observed here are found in similar habitats along the coast of the southern Namib, but as several of the species are endemics, and/or protected. Several more species of conservation concern have been recorded in this area previously, although they were not seen during the survey. These include some endemic red data species and protected species.

Conservation rating of this zone: 4

Figure 6-3: Crassula atropurpurea var. cultriformis, a protected endemic species found in Zone A

Figure 6-4: Area before Swartbult, rich in C. atropurpurea var. cultriformis

Zone B: Unstabilised gravel and sand flats and hummocks

From Swartbult to the footslopes of the Schakalberge the prevailing habitat is one of gravely-sandy flats and slopes and dune hummocks. This sandy zone is dominated by common species such as those shown in Figure 6-6 and Figure 6-7. No species of high conservation concern were observed. Diversity drops closer to the Schakalberge. The area at the edge of the footslopes comprises mobile dunes where only grass species were observed. This zone is not sensitive from a vegetation aspect and has been given a conservation rating of 1.

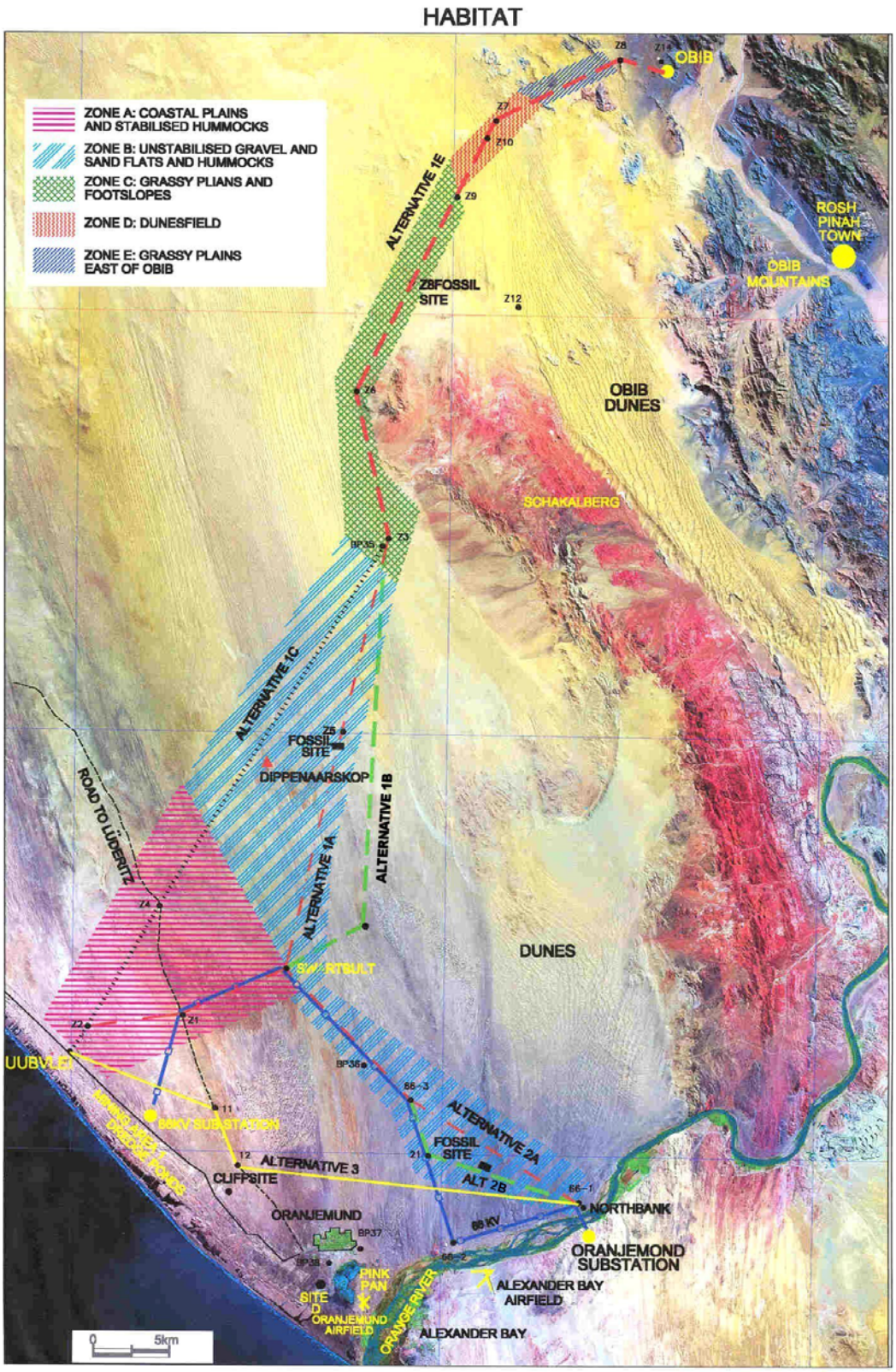


Figure 6-5: Distribution of vegetation around Oranjemund

Figure 6-6: Sandy hummocks dominated by Cladoraphis spinosa and Brownanthus arenosus

Figure 6-7: Gravely-sandy flat dominated by Brownanthus arenosus

Zone C: Grassy plains and footslopes

The valley to the west of the Schakalberge (Figure 6-8) is dominated by *Stipagrostis geminifolia*, a common southern African grass. The more gravely footslopes support large numbers of *Zygophyllum clavatum* shrublets, and *Augea capensis*, a common annual succulent.

This habitat continues beyond the Schakalberge ridge until it reaches a rocky koppie at 27° 55.74' S and 16° 30.07' E. This koppie supports a far higher plant diversity than the surrounding plains, and should be avoided if at all possible. Beyond the rocky koppie the grassy plain continues for a short while, gradually becoming sandier, until it encounters a short stretch of dwarf succulents.

Diversity is far higher on the mountain slopes, where numerous endemic, protected and red data species are listed. These were not assessed because the proposed routes bypass them.

The conservation rating of this zone is 1, provided the mountain slopes are avoided.

Figure 6-8: Low diversity on plains below the Schakalberge

Zone D: Dune fields

The dune fields in this zone are interspersed by sandy dune valleys. Vegetation on the dunes is not very diverse, with about four species including the protected, near-endemic !nara, *Acanthosicyos horridus* occurring there. Thus, in general this is not a sensitive zone. However, at one or two spots too small to zone individually the diversity is far higher, and includes species such as shown in Figure 6-9. A Conservation rating of 2 has been assigned to this zone.

Figure 6-9: Higher diversity spot in the dune zone (Zone D) with the tall Zygophyllum prismatocarpum in the background

Zone E: Grassy plains east of Obib

These plains are dominated by *Stipagrostis* spp. and other grasses. Remnants of annual daisies such as *Foveolina dichotoma* were also seen. One rare species, *Haemanthus pubescens* subsp. *arenicola* (Figure 8) was collected on the plains beyond a dolomite koppie. More diverse areas surround these plains, mainly on footslopes of outcrops. The outcrops are well known and documented to harbour a high species diversity as well as many protected and endemic species. They should be avoided by the power lines.

Figure 6-10: Grassy plains near Obib

Figure 6-11:* Haemanthus pubescens *subsp.* arenicola*, a rare geophyte found blooming on the grassy plains west of Obib

6.7.4 Implications and criteria for route planning

- No plant species of sufficient conservation concern were found in any of the above habitats to warrant rejection of any of the routes proposed, or to justify any costly rescue operations. This is on condition that damage to the areas concerned be limited to the absolute minimum as specified in the EMP (to be developed).
- The Namibia-bound route via Swartbult is slightly preferred above its short-cut alternative via Dippenaarskop, since the plant diversity is much higher there.
- All slopes, outcrops and inselbergs should be avoided as they harbour the greatest diversity and numbers of conservation worthy plant species.

6.8 Fauna

6.8.1 Community and stakeholder concerns

The habitat around Oranjemund has already been significantly disturbed. Stakeholders are concerned that more infrastructures will cause even further damage to the habitat.

6.8.2 Methodology and data sources

The work on fauna for this study was entirely desk study based. The work conducted in the Preliminary Environmental Assessment and the recent Environmental Impact Assessment of the proposed CCGT Plant provided the bulk of the information for this study (the same ecologist visited the area during the latter study). Different habitats were previously mapped for the above studies. The vegetation specialist was tasked to refine this map particularly where the power line route alternatives lie. She also concentrated on defining disturbed land. This provided the fauna specialist with a clearer picture of where further disturbance to habitat may be expected as a result of this project.

6.8.3 Description

Introduction

The distribution of habitats crossed by the power lines are shown in Figure 6-5. Defining the boundaries of the zones is difficult because the zones blend into one another and because in many cases they form a fine mosaic of patches.

As in the rest of the Namib, the Sperrgebiet is home to a very diverse fauna that reflects the adaptations of various animals to the diverse habitats. For instance, there are fog-dependent frogs, an impressive 80 species of reptiles that are their most diverse in the geckos, skinks and sand lizards that make use of different zones in dunes and the kinds of substrate they offer for shelter and refuge, and 20 species of rodents (Griffin 1995). The Sperrgebiet, especially in the south, being a winter-rainfall area, differs from the central Namib sand sea in its abundance of vegetation, even through the dry season. The succulent plants provide a relatively steady source of food and shelter for arthropods and small vertebrate animals such as lizards and mice. Thus total species numbers for these groups in the Sperrgebiet are

higher than in the central Namib. Also, animals that are more abundant in the mountainous areas to the east of the Sperrgebiet are found marginally in the rocky outcrops and inselbergs of the Sperrgebiet itself, adding to the diversity (Pallett 1995).

Lists of amphibian, reptile and mammal species that can be expected or are known to occur in the project area, compiled using the Sperrgebiet list of Griffin (1995) are shown in Appendix A to the specialist report. This provides details of the animals that may be encountered during project implementation, and can be used to alert the people involved in what to look out for. The list also provides information on the preferred habitats and conservation status of the animals.

Species listed as endemic are endemic to Namibia, not necessarily endemic to the Sperrgebiet itself or the project area *per se*. Due to the poor coverage of animal collecting in the Sperrgebiet, the ranges of many species are estimations based on scattered and/or isolated records, very often at the edges of the Sperrgebiet such as along the eastern boundary and south of the Orange River. So knowledge is quite limited, making prediction of impacts of the power lines on the fauna more difficult.

Coastal plains and hummocks

Uubvlei, the starting point of the power lines, is situated in an area of low hummocks, and this habitat type is widespread in the Sperrgebiet within about 5 km of the coast. Large parts of this habitat within Mining Area 1 have been disturbed or severely degraded by diamond mining operations. Further inland, up to about 15 km from the coast, hummocks are less distinct and the substrate is gravely-sandy plains

The low hummocks form around low woody and bushy plants, such as *Stoeberia, Salsola* and *Brownanthus that* grow as 'cushions' up to about 0.5m high. Lichens are an important feature in this habitat, growing on the woody stems and leaves of the plants. Lichens in general in Namibia are poorly known, and this area even less because of the restrictions of Diamond Area 1 (Wessels 1994), so it is not known if any species are endemic to a limited area here, or are of any conservation significance for other reasons.

On the fauna side, most of the ecological action in this area, like in much of the Namib, is carried out by small animals that can shelter from the harsh conditions of strong winds and meagre rainfall, and that can take advantage of the moisture provided by fog. Evidence of animal activity is seen in spider webs in most of the plants, tracks of snails, beetles, lizards, snakes, larks and hares on the ground, tracks of beetle larvae and legless lizards just beneath the surface, burrows of scorpions and small rodents, and various other signs of cryptic life.

The habitat supports a well-developed, mainly sand-living invertebrate fauna with a large but unspecified number of endemic species (Marais 1998).

Two frog species, desert rain frog and Namaqua rain frog, are found in this habitat. The former, *Breviceps macrops*, is noteworthy as it might even be a separate species from adjacent Namaqualand populations. If this is the case, Namibian responsibility for this species, (presently classified as Insufficiently Known & Endemic, Griffin 1999) would increase considerably (Griffin 1998). This unusual frog depends on fog moisture, confining it to a thin belt close to the coast, and lives in sandy hummock habitat in the Sperrgebiet only, much of which has been or will be destroyed in diamond mining operations.

Amongst reptiles, species of concern are the Namaqua dwarf adder (*Bitis schneideri*), and classified as Insufficiently Known [Griffin 1999]) and possibly some underground-living lizards (legless skinks of the genus *Acontias* and *Typhlosaurus*) which have still to be confirmed. These species are also confined to the coastal vegetated hummock habitat, and are thus threatened by mining activities (Griffin 1998).

All of the mammals of conservation significance that occur in this habitat have distributions that extend well beyond the project area.

Unstabilised gravel and sand flats and low dunes

Areas to the east of the coastal plains comprise gravely and sandy flats, low dunes and hummocks, and dunes proper. The substrate is variable: in some places it is firm, even hard in the case of consolidated fossil dunes, in others very loose and fine-grained, such as on dunes. In the majority of places it is semi-stabilised by low succulent shrub vegetation and grasses (Burke 1998).

Invertebrate fauna comprises the wealth of insects, spiders and scorpions that are adapted to living in and on sand, for which the Namib is renowned. The same goes for species of reptiles and small mammals. Although the sandy substrate is not as clearly sculptured into dunes in this area as occurs further north in the central Namib sand sea, the areas are continuous with each other and there are unlikely to be any animal species with restricted geographic distributions here.

The species lists show that there are 49 reptile species and 41 mammal species known or expected to occur in this habitat. Some of these species (e.g. veld leguaan, yellow mongoose) are probably found here only when good rainfall allows expansion of their ranges westwards into the desert proper. Of the reptile species, three are of conservation concern: the leopard tortoise, tent tortoise and veld leguaan. Amongst the mammals, 8 species are of conservation concern: seven of these are carnivores that are persecuted by farmers, and the last, the small grey mongoose, is probably a vagrant in this area. Persecution is not an issue in the Sperrgebiet, so the cause of their status as Vulnerable does not apply in the project area. Nevertheless, their populations should not be disturbed, as set out in the mitigatory actions suggested later in this report.

Rocky outcrops and inselbergs

Areas of rocky outcrop occur sporadically throughout the project area. These form small rises and low hills usually flanked by accumulated sand, and the large Schakalberg mountain is a very prominent feature of the area. Their geology and vegetation vary, but the significant feature is that they catch moisture from fog precipitation and retain it in crevices and cracks in the rocks, so support greater densities and varieties of plants than the surrounding sandy areas. These in turn support more fauna. The rocky outcrops, inselbergs and mountains are therefore the most sensitive habitats in the project area, and should be avoided as much as possible.

The red marble frog uses rock pools to breed and hides in crevices during the long dry season. Twenty-two species of reptiles in the project area depend on rocky substrates. Of these, eight are endemic to Namibia, and none are known to be threatened. However, caution is advised for two species, rough-scaled gecko and dwarf mountain adder, which are insufficiently known to be able to give reliable estimates of their conservation status.

Twenty-two species of mammals in the project area depend on rocky substrates and mountainous terrain: half of them require proper mountains providing caves, shelters and high relief such as is found on Schakalberg (e.g. bats, leopard, Hartmann's mountain zebra), while the others use rocky substrate for the firm substrate it provides to burrow into. Hartmann's mountain zebra is the only species in this group that is classified as Vulnerable, and there are three species that are endemic to Namibia.

6.8.4 Implications and criteria for route evaluation

- To protect the protected fauna found in rocky outcrops and inselbergs, the power lines should avoid these habitats.
- The extent of power lines crossing pristine habitat should serve as a criterion for evaluating the environmental suitability of the route alternatives.

6.9 Birds

6.9.1 Stakeholder and community concerns

Although not expected to be an issue, the Oranjemund community nevertheless requested that potential bird collisions be addressed, given the proximity of the dredge ponds to the Uubvlei site from where the power lines will originate.

Data sources

In previous studies conducted by the author in 2004, the approved alignments for a 400 kV and 220kV line to Site D were assessed from a bird impact perspective. The bird specialist was in a position to comment on likely bird impacts for this study without the need to visit the area again. Both the studies conducted for the EIA of the power lines from Site D, and the later addendum written for this study, are attached as Appendix 2.

6.9.2 Description

Bird habitat and diversity within the ORMWP

Apart from the Orange River Mouth being a Ramsar site, it is also recognised as an Important Bird Area (Barnes 1998). Although the number of waterbirds has decreased since the site was first designated as a Ramsar site in 1991, it still meets three of the four Ramsar criteria under which it was originally designated. In particular it continues to support more than 1% of the southern African and global populations of several waterbird species (Anderson *et. al.* 2003).

Waterbirds use a variety of areas in the Ramsar site, but large concentrations have been recorded at islets in the river floodplain, the oxidation ponds, on the sandpit and exposed tidal sand bank, and the lower end of the salt marsh. During six recent surveys, the largest proportion of waterbirds was counted at two wetland areas, namely the salt marsh (12.1%-37.3%) and the north bank, adjacent islands and Namibian beach area (24.5% - 44.9%). The peripheral wetlands (Pink Pan, Yacht Club, lucerne fields pan) support relatively fewer birds (Anderson et al, 2003).

Although the Pink Pan does not usually support huge numbers of birds, Red Data species have been recorded there during bi-annual counts, including Great White Pelicans, Lesser Flamingos and Swift Terns (Anderson & Kolberg unp.data).

Other important habitat outside the Ramsar site (between Hohenfels and the Oppenheimer Bridge) is the rocky outcrops and cliffs in the vicinity of the current 66 kV river crossing and support breeding Peregrine Falcons (M. Anderson pers.comm). This is used by a variety of birds (including Lanner Falcons *Falco biarmicus*, Spurwinged Geese *Plectropterus gambensis* and Egyptian Geese *Alopochen aegyptiacus*) for perching, and (presumably) roosting (pers.obs). There is also bird movement up and down the river channels and sandbanks in this section, including South African Shelducks, Egyptian Geese, Spurwinged Geese, Grey Herons *Ardea cinerea*, African Spoonbill *Platalea alba*, Cattle Egret *Bubulcus ibis*, Hadeda Ibis *Bostrychia hagedash* and Caspian Terns (pers. obs). In 1997, a Great White Pelican collision was recorded at the 66 kV river-crossing (Anderson unp.data), and this species was recorded in this area during bi-annual counts (Anderson & Kolberg unp.data).

Another important habitat (for purposes of this study) is the dredge ponds along the coast in the mined out areas. Flamingos have been observed on these ponds by Namdeb staff (M. Soroczynski pers. comm.). It is very probable that movement between these areas and the Pink Pan takes place.

Figure 6-12 illustrates the locality of important bird habitats and flight paths in the project area.

6.9.3 Implications and criteria for route planning

- The occurrence of bird flight paths and unlikely conflict with these paths along the route alternatives should be noted.
- Habitat disturbance and important breeding sites should be considered at the Orange River crossing.

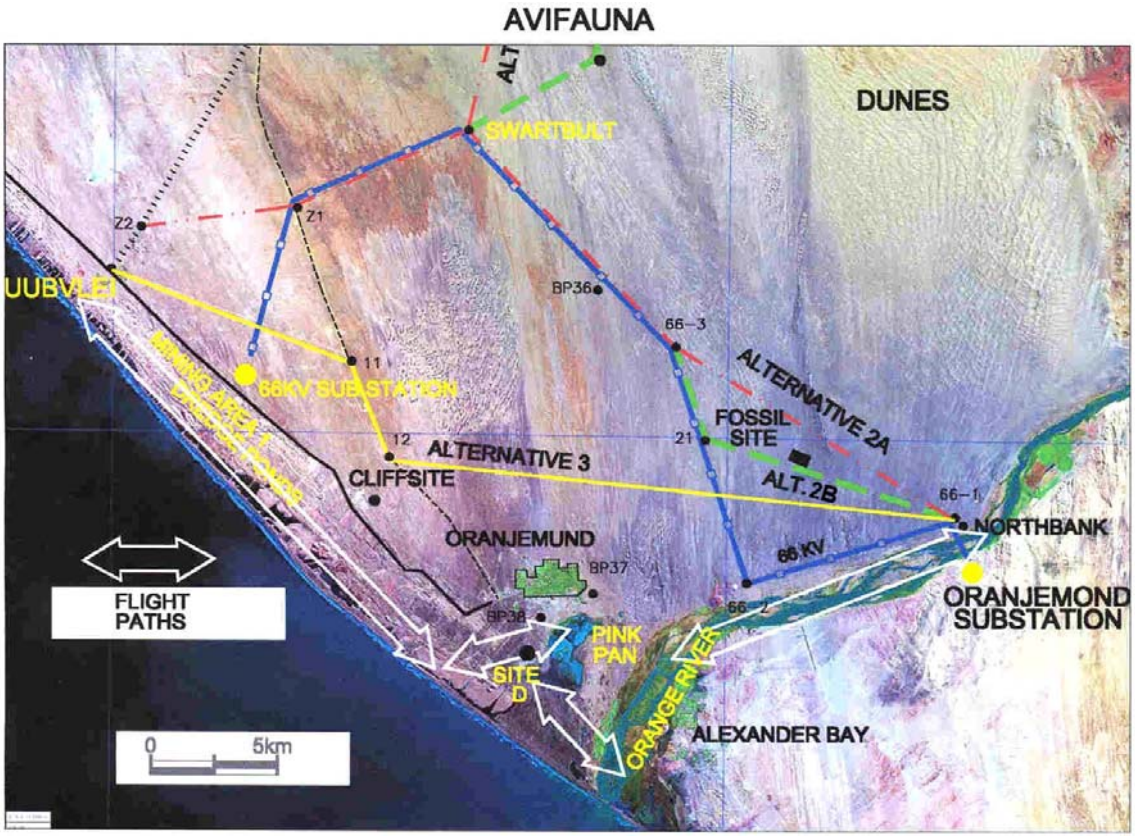


Figure 6-12: Important bird habitats and flight paths in the study area

6.10 Archaeology

The full report on the archaeological study for this EIA is attached as Appendix 3.

6.10.1 Data sources and methods

Starting with an in-depth literature review, the study continued with a comprehensive field survey in March 2005. These efforts built on previous work done in the area for the proposed power station and associated power lines at Site D and Cliff Site. The results were then discussed with respect to the known archaeology of the area.

6.10.2 Description

Related archaeological and historical information suggest that materials from Early Stone Age, Middle Stone Age and Late Stone Age, covering the period from about one million years ago to the present, can readily be found in the entire Sperrgebiet.

This is evidenced by the discovery of 13 archaeological sites during the survey done in 2004, and an additional 21 sites discovered during the current study. 16 sites located in the general area were discovered in 1995 and another 16 sites in 2002.

Seven of the sites discovered during the power lines EIA for Site D, are particularly interesting due to their being associated with land snail middens. At this stage the use of land snails by early man is poorly understood and under researched, so that every little bit of evidence can potentially help, even if some of the sites concerned are not very extensive. Apart from the contents of the sites, their patterns and spatial distribution are of interest as well. They must not be disturbed at this stage.

Figure 6-13 shows the sites identified during this study and during the previous surveys.

During this study, four additional sites of particular value were discovered. The first is a highly unusual collection of three obviously man-made heaps of snail shell, indicating intense land snail exploitation at that point. The second is a veritable midden of ostrich eggshell, mixed with other artefacts, showing that ostrich eggs were extensively utilised at this point. The third is enigmatic for its grindstone with the three unique and completely inexplicable holes drilled in it, whereas the last site is important both for the high quality of pottery it contains and for the fact that it contains sea shells. The first fact dates the site to the last 2000 years, whereas the latter shows that the people concerned, who lived 70 km from the sea, had some sort of direct or indirect contact to the coast.

6.10.3 Implications and criteria for route planning

The conservation worthy sites mentioned can all be protected by fencing and signposting them before construction starts. Their existence therefore do not affect the route alignment.

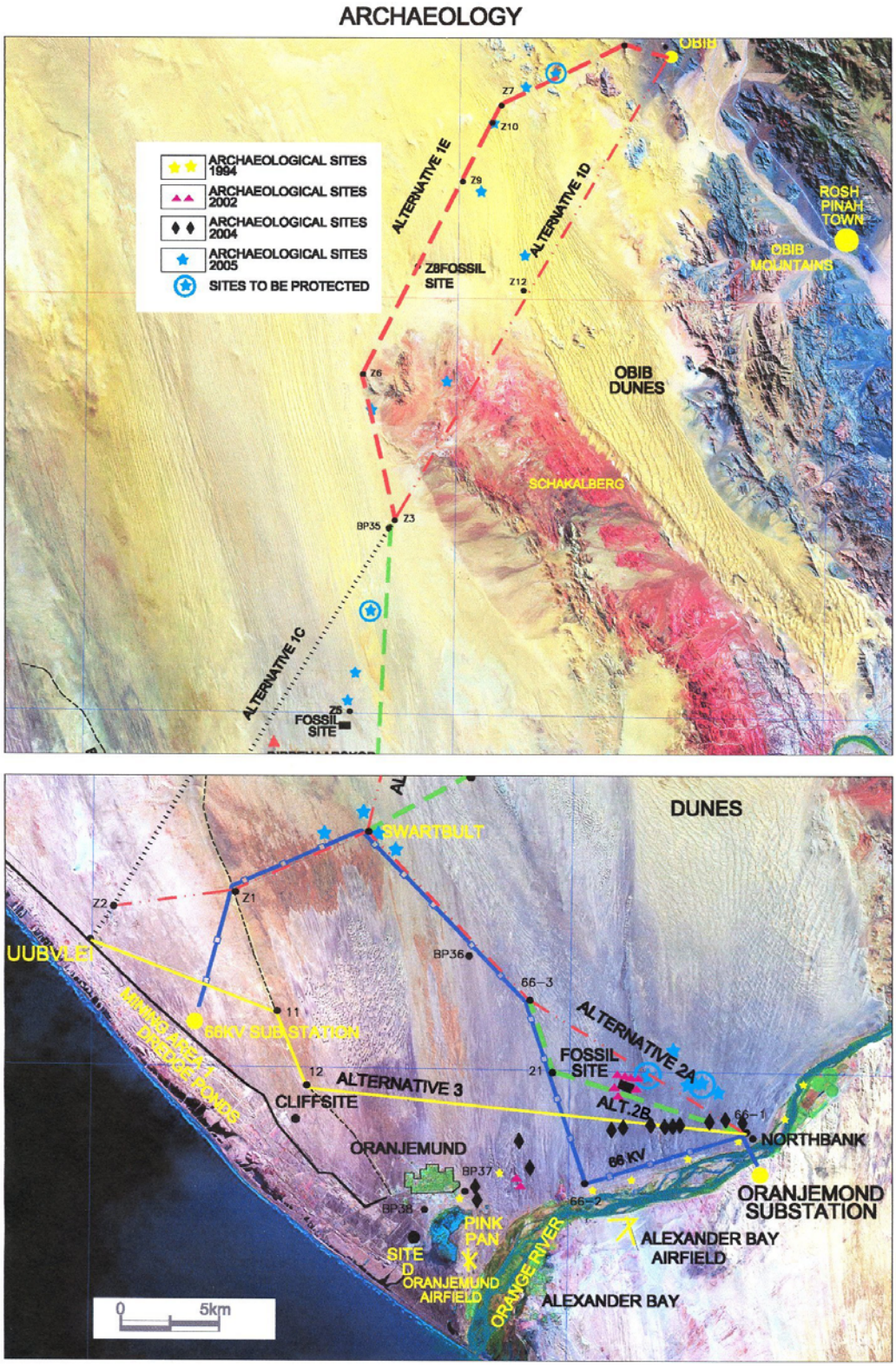


Figure 6-13: Location of archaeological remains around Oranjemund

7 Route Evaluation and Assessment

7.1 Methodology

The Terms of Reference of this study required the EIA team to evaluate the proposed routes and their possible detours or shortcuts in terms of their potential impacts on the bio-physical and socio-economic environment. The team was tasked to discuss the bio-physical and socio-economic as well as technical and financial pros and cons of the routes where appropriate.

The first step for route evaluation was to consider all stakeholder and community concerns, and sensitive environmental aspects, and how the proposed new power lines would affect them. A list of potential impacts was subsequently compiled, which also served as criteria for route evaluation, together with technical and financial aspects. The list of potential impacts considered during the study is summarised below.

7.2 List of potential impacts

Table 7-1 provides a list of criteria that was used for evaluating the suitability of the routes from an environmental and socio-economic point of view.

Aspect	Criteria	Rationale
Mining	*Avoid areas where diamondiferous reserves are located unless they can be mined out before construction of the power lines.*	• If the power lines are built over potential diamondiferous reserves, they will be locked up, and the resource use and associated economic benefits will be lost.
Infrastructure	*Use existing corridors*	• Aligning the route along existing infrastructure corridors such as the current 66kV power line, would limit the need to disturb pristine areas and increasing visual intrusions to the landscape.
Visual impact/tourism potential	*Avoid areas suitable for future tourism development*	• Protect visual quality along important vistas and areas with particular wilderness qualities, as these may become important tourism attractions in future. • Keep the power lines off higher ground, and rather align them in valleys and lower lying areas where they will be less obtrusive.
Vegetation	*Avoid vegetation zones that harbour conservation worthy and protected species*	• To maintain the integrity of conservation worthy plant populations.
Topography	*Avoid high or shifting sand dunes, rocky outcrops and inselbergs*	• Shifting sand dunes may present unstable founding conditions for pylons. These areas are difficult to access, and would complicate and increase construction costs. • Rocky outcrops and inselbergs are normally sensitive from an ecological aspect and should be avoided.
Archaeological sites	*Avoid vulnerable and important archaeological sites*	• Archaeological sites are important from a scientific, cultural, scientific, tourism and legal perspective. • However, they can normally be protected (fenced in or removed) without having to move a route entirely.

Birds	*Avoid crossings with flight paths for power line sensitive birds* *Avoid important bird habitats*	• Birds flying between habitats are prone to collide with power lines crossing their flight paths. This is particularly true for larger birds such as flamingos.
Community preference	*Consider community preferences when choosing routes*	• The concerns of the potentially affected community need to be considered and addressed as part of the EIA process. • In this case, some Oranjemund community members pledge their full support for the station and power lines at Uubvlei, because it is far removed from the town and its recreational areas.
Construction costs	*Factors affecting construction costs should be considered*	• The length of power line increases construction costs, thus the need for detours should be carefully considered.

Table 7-1: Criteria used to evaluate the environmental and social suitability of the proposed route alternatives.

7.3 Evaluation and assessment

This section describes the expected impacts on the natural and socio-economic environment if the power lines are to be built along the proposed routes from Uubvlei. Where there are differences between two alternative legs of a route, these are pointed out.

The following criteria were used in assessing and describing the impacts of the routes.

Description	The type of effect that a proposed activity will have on the environment. A narrative of the impact.
Extent	Geographic area. Whether the impact will be within a limited area (on site and immediate surroundings, LIM)), locally (within the power line corridor; L), regionally (R), nationally (N) or internationally (I).
Duration	Whether the impact will be temporary (during implementation only; T), short term (1-5 years; ST), medium term (5-10 years; MT), long term (longer than 10 years, but will cease after operation LT), permanent (P) or transient (TR).
Intensity	Whether the impact is destructive or harmless. Low (L) where no environmental functions and processes are affected, Moderate (M) where the environment continues to function but in a modified manner or High (H) (environmental functions and processes are altered VH Environmental processes cease completely. May also be measured in accordance with acceptable standards, applicable conventions, best practice policy, levels of social acceptance, etc.
Mitigation	Discusses mitigation options, and whether such options would lessen the impact to an acceptable level.
Probability	The probability that a certain impact will in fact realise; Uncertain (U), Improbable (I), Probable (P); Highly Probable (HP); Certain (C). If the probability is uncertain, then there is not sufficient information to determine its probability. Because the precautionary principle is followed, this increases the significance of the impact.
Significance	Low if the impact will not have an influence on the decision or require to be significantly accommodated in the project design, Moderate if the impact could have an influence on the environment which will require modification of the project design or alternative mitigation (the route can be used, but with deviations or mitigation) High where it could have a "no-go" implication regardless of any possible mitigation (an alternative route should be used). Significance is given before and after mitigation.

7.3.1 Diamond reserve lock-up

Community and stakeholder concerns

There may be diamond reserves locked up under parts of the power line routes.

Discussion

During the EIA study of the power lines originating from Site D, Namdeb took stock of all reserves located under the proposed power line routes.

At the time it was indicated that potential diamond reserves are likely to occur in an old channel of the Orange River north-east of Oranjemund. The power lines from Uubvlei will cross this same area.

Namdeb's exploration work in this area has been limited, and they are not able to confirm particular locations of lock-up, if any. Further exploration work is scheduled for 2005, after which a conclusion may be reached. Figure 7-1 shows where the potential reserves are located.

The section of the route within Mining Area 1 as it leaves Uubvlei could also lie on remaining diamond reserves. Although Namdeb verbally indicated that mining in this area has been completed, formal confirmation to this effect should be obtained.

Two alternative legs have been suggested to bring the power lines to the Orange River crossing. The one alternative is a straight leg passing to the north of GP Pan. The other is an indirect route past the southern end of GP Pan. The final route selected will depend on the final outcome with respect to the locality of diamond reserves in this area.

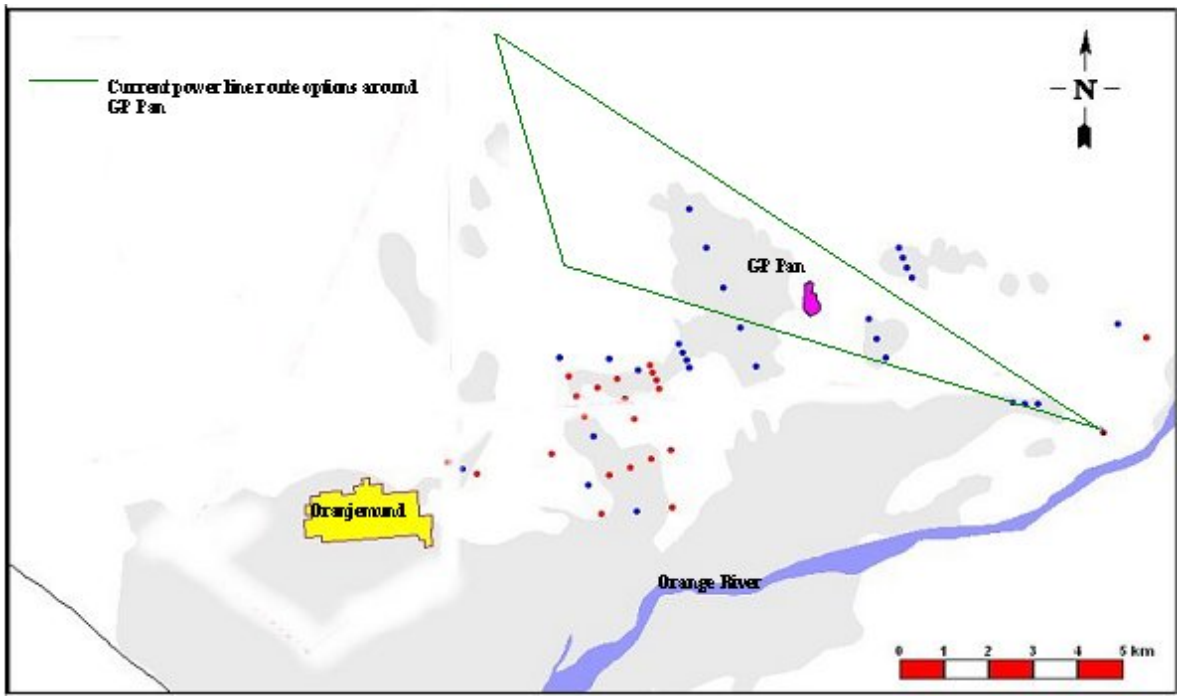


Figure 7-1: Location of proposed power line routes north of the Orange River in relation to potential diamond reserves in the Paeleo Channel of the Orange River (Blue and red dots show the location of preliminary exploration efforts)

Summary

Description	• Potential diamond reserves locked up in the paeleo channel along the routes north-west of the river crossing, and in Mining Area 1 near Uubvlei.
Extent	• Local
Duration	• Long Term
Intensity	• High
Probability	• Uncertain
Mitigation	• NamPower should liaise closely with Namdeb so that exploration work along the paeleo channel of the Orange may be finalised. • Depending on the locality of the diamond reserves, the power line should be navigated around them, while considering other environmental aspects.
Significance Before mitigation	• Potentially high
Significance after mitigation	• Potentially high if the power lines cannot be navigated around the diamond reserves.
Conclusion	• Namdeb should be requested to finalise their drilling activities in the Paeleo channel of the Orange River, and to confirm the locality of the diamond reserves. Namdeb should also confirm that there are no diamond reserves remaining in Mining Area 1 East of Uubvlei.

7.3.2 Visual Impact

Community and stakeholder concerns

The Oranjemund community believes that the proposed power lines from Uubvlei would be less problematic visually, because they are far removed from important views around the town. The remaining areas of key concern from a visual impact point of view are the river crossing, and the stretch from Obib to Schakalberg. MET staff are concerned that the visual intrusion will reduce the tourism potential in this pristine wilderness area.

Discussion

The visual impact of a power line is determined to a large extent by the individual observer's perception of the impact. This will be based on their emotive and observational capacities, their knowledge of landscapes, the position from which it is experienced, and the accumulation of aesthetic experiences derived from it (Lucas, 1996 cited in WEC, 1998). No one individual will be in complete agreement on the scale or degree of impact they see. For example, a person who sees large man-made structures as a symbol of economic progress is likely to have a different perspective of visual impact than the purist who will see the power line as a major intrusion.

However, there is a general opinion that power lines strung across the countryside do detract from what may otherwise be considered a pleasing view. The degree of visual impact may be measured against the extent to which the new structures are likely to change the qualities of the existing landscape. If one places a pylon in the foreground of a natural scene with no other man-made structures, then that pylon considerably changes the visual qualities of the scene, so the visual impact will be high. A pylon placed in an industrial area with similar man-made structures, does not radically change the scene, and the visual impact is low.

The 1998 study of WEC conducted for the 400kV power line from Keetmanshoop to Obib considered the visual impact of the line. The study concluded that the Obib-Oranjemund route has less social, environmental and economic costs than the route option along the Orange River. Its one big drawback, however, is that it impinges on a virtually untouched area.

The pylons to be used are strain towers around bends and self-supporting and suspension towers along the straight sections. The towers will be a maximum of 35 m high, which is similar to the height of a 12-storey building. The strain towers are bulky, and there will eventually be three of the lines running parallel to each other on the route to South Africa, and one line running towards Obib to feed Namibia.

It is the latter section of the route where visual impact is of specific concern. The Ministry of Environment and Tourism is positive that this area has great potential for eco-tourism activities, mainly because of its exceptional wilderness qualities.

During the helicopter survey, the team considered the original route from Obib to Schakalberg. (See Figure 1-1) Whereas the original route cuts straight across higher ground towards Uubvlei, changes were made to rather keep the line to valley bottoms, behind hill crests and to avoid inselbergs altogether.

The route selected through the desert, is therefore considered the best option to minimise environmental, social and economic costs. A few small adjustments may need to be made during the final route selection to avoid hill slopes, ridges and dunes.

Another area where the power lines will be highly visible is at the Orange River crossing. This crossing will be highly visible and obtrusive, but is unavoidable. The power lines are kept in one corridor with the existing 66 kV line already crossing the river at this point.

Construction activities can lead to significant visual impact, if they are not adequately managed. Untidy work areas, windblown litter and unnecessary tracks can all degrade the present scenic beauty of the desert in the study area.

Figure 7-2: The Obib Mountain area near Skorpion, with its attractive wilderness qualities.

Summary

VISUAL IMPACT	
Description	• The pristine desert area, particularly from Obib to Schakalberg is visually sensitive and will be highly affected. • High impact at the river crossing.
Extent	• Locally
Duration	• Long Term
Intensity	• High
Probability	• Certain
Mitigation	• Limited • If paint is required, keep colours to grey tones. Otherwise pylons should be kept unpainted. • Control littering, waste and unnecessary tracks during construction
Significance before mitigation	• High
Significance after mitigation	• High
A high visual impact may be expected where the power lines cross the Obib Mountains towards Schakalberg and the Orange River Crossing. A compromise has been reached to accept this impact as a trade off for other, more serious bio-physical and social impacts if the route was to follow the Orange River. The current route has however been revised to avoid higher ground, and has, apart from some small adjustments, been optimised to reduce visual impact.	

7.3.3 Bird impacts

Stakeholder and community concerns

The local community is concerned that the power line sensitive birds may collide with the power lines. Electrocution of birds is also a concern, as well as the potential of increased nesting sites for crows, with a resulting increased crow population.

Description

The proposed structures all have overhead shield wires for lightning protection. It is generally accepted that the shield wire is the main threat to flying birds as it is a thin steel wire approximately 14mm in diameter. This makes it a lot less visible than the thick bundled conductors as is demonstrated in Figure 7-3 below. **None of the structures pose any electrocution risk to birds.**

Figure 7-3: Visibility of shield wires vs. bundled conductors

The major flight paths for birds around Oranjemund are shown in Figure 6-12. The new proposed alignments from Uubvlei will most likely not cross any major flight paths. Of particular importance is that the new alignments will not, as the previously approved alternative from site D, cross between the Pink Pan and the dredge ponds along the coast. This created the possibility of flamingo collisions as the birds move between the coast and the Pink Pan, especially during misty conditions when bird flight diverters are less effective.

The Orange River represents a major bird flight path. The new proposed alignments cross the Orange River, so potential bird collision at this crossing is a concern. Eskom should be made aware of this aspect for inclusion in the EIA of the power lines on the South African side.

It is possible that Pied Crows might attempt to nest in the lattice work of the towers. The majority of the towers are cross-rope suspension types, which means the birds will nest away from the conductors in the two columns (provided enough support exists in the lattice work). This should not have any effect on the quality of supply.

Some of the towers will be self-supporting towers. In these instances the crows could potentially nest above the conductors, but this would again depend on whether the specific tower type that will be used will provide enough support for the crows to nest. In the event of a crow nesting directly above a conductor, there is the possibility that nesting material, specifically pieces of wire or plastic rope could cause a flashover across the air gap between the conductor and the intrusion, especially in wet conditions. It must be emphasised that this would be an uncommon event, although it has been recorded in South Africa. The crows themselves are too small to cause a problem with their streamers (excreta) on lines of this size. The best option would be to monitor the situation to see if any crows indeed nest in critical areas and then address the problem in an appropriate manner e.g. by blocking the nesting area and shifting the nest to a platform somewhere else on the tower.

Summary

BIRD IMPACTS	
Description	• Flight paths for power line sensitive birds are avoided, except for the Orange River crossing, which does for form part of the scope of this study. • The pylons may attract crows' nests, but this should not affect power supply.
Extent	• Local
Duration	• N/A
Intensity	• Low
Probability	• Improbable
Significance before mitigation	• Very low
Significance after mitigation	• Very low
Mitigation options	• Monitor crows' nesting and block critical sites if needed. • Inform Eskom of the bird collision aspect at the Orange River Crossing.
Summary	The risk of potential bird collisions and electrocutions as a result of the proposed power lines from Uubvlei is very low. The power lines do not cross any power line sensitive bird flight paths or nesting grounds, except for the Orange River Crossing. The Orange River crossing will be covered in an EIA to be commissioned by Eskom. The occurrence of crows' nests are not expected to influence power supply, but should be monitored during operation.

7.3.4 Impacts on fauna

Stakeholder and community concerns

It is known that the habitats in the Sperrgebiet harbour a variety of rare and endemic fauna. Since these habitats have already been widely disturbed they are becoming reduced and thus increasingly unable to support the conservation worthy animals found in the area. The scientific community is concerned that increased construction activities would eventually destroy the habitats and species they support.

Description

Obviously, construction will involve earth-moving and damage to plants and animals in the process of making tracks, clearing vegetation around the feet of the pylons, vehicles driving along the route during surveying, erection of pylons and hanging the wires, and similar impacts of construction activities. Poorly supervised contractors and/or poor management of the construction process could lead to the area of disturbance to animals being much wider than necessary.

While animal species occurring in the sandy and hummock habitats generally have wide distributions, those that are found on rocky outcrops and mountains are much more habitat-specific and have more restricted distributions. This is the main reason for routing the power line to avoid, as much as possible, traversing outcrops and mountainous terrain.

It is recommended that construction activities be confined to the immediate area of each pylon and track between them, to prevent the disturbance spreading outwards unnecessarily. Vehicle tracks in this habitat stay visible for a long time, up to decades, and so these should be kept to an absolute minimum. Conscientious and thorough supervision of contractors and their activities will greatly help to prevent unnecessary damage.

As long as the 'footprint' of the power line is reduced to the minimum through close supervision of the construction process, and is routed to avoid traversing rocky outcrops, the disturbance will affect only a thin linear strip traversing this large expansive sandy area. This impact is not viewed as significant to the fauna, in the broad picture.

Introduction of workers into an area where large animals such as gemsbok and springbok roam freely is bound to result in attempts to poach them, most likely using snares. Opportunities to poach will mainly arise if workers have lots of free time on site. If they are occupied whilst in the area, and, where possible, transported out of the area over weekends, the chances to poach or lay traps will be greatly reduced, but not altogether removed.

This impact can be mitigated by close supervision of the labour force during construction, and by accommodating labourers in Oranjemund or Rosh Pinah when they have free days.

Summary

DISTURBANCE TO HABITAT AND FAUNA	
Description	• Habitat destruction and disturbance to animals, particularly if the construction process continues un supervised. • Poaching and collecting of animals during construction.
Extent	• Local
Duration	• Temporary
Intensity	• Low to moderate
Probability	• Habitat destruction certain • Poaching highly probable
Mitigation options	• Strict discipline and thorough supervision of contractors and the workforce during construction. • House labourers in Oranjemund, Uubvlei or Rosh Pinah. • Confine construction activities to the immediate area. • Make minor adjustments to completely avoid rocky outcrops and inselbergs.
Significance before mitigation	• Moderate
Significance after mitigation	• Low
Summary	• Provided rocky outcrops and inselbergs where faunal diversity is high and distribution of species is more limited, the impacts of fauna will be low and limited to the construction phase of the project. Construction activities should be controlled to limit the area of disturbance.

7.3.5 Impact on vegetation

Scientific and community concerns

A concern exists that vegetation cover will be damaged and lost as a result of construction activities and vehicle tracks. The plant diversity in the study area is high and many of the species are endemic to the region and protected by law.

Description

The table below provides an indication of the level of sensitivity of each vegetation zone identified. It gives general directions of what mitigation.

Zone A **Coastal plains and stabilised hummocks** **Conservation Rating 4**	This zone covers the area from Uubvlei where the power lines will originate. There will have be several power lines traversing this area. Most of the vegetation in this zone is found in similar habitats along the coast of the southern Namib, but several of the species are protected endemics. The route via Swartbult crosses an area rich in *Crassula atropurpurea var. cultriformis* and *C. plegmatoides*. They are all protected endemic species. The route via Swartbult is slightly more preferable than the route via Dippenaarskop, because of the greater plant density and diversity along the latter. Access tracks and turning points must be identified and demarcated before construction starts. Track discipline will be crucial for this zone. If destruction is limited, later re-colonisation may be expected.
Zone B **Unstabilised gravel, sand flats, and hummocks** **Conservation Rating 1**	This is not a sensitive vegetation zone as no species of conservation concern were noted. All species in this zone are common, and the diversity is comparatively low.
Zone C **Grassy plains and foot slopes** **Conservation Rating 1**	This is not a sensitive vegetation zone. It is dominated by common Southern African grass species. The route presently cuts across the foot slopes of the Schakalberg and a rocky outcrop in the vicinity. Plant species on the slopes and outcrops are much more diverse and sensitive. It is recommended that the route be slightly amended to avoid the foot slopes and outcrops.
Zone D **Dune fields** **Conservation Rating 2**	Generally not a sensitive zone, but a few spots with higher diversity, more sensitive plants occur. Although the species in the high diversity spots are not species of very high conservation concern, several have restricted distributions in Namibia. Turning points and tracks must be made where diversity is lower. *Acanthosicyos horridus* is a protected species, but is widespread. In the area where they occur the individuals are spread out in a more-or-less linear fashion along the edge of the dune field, which will be crossed at a short tangent by the power line route. It is thus anticipated that only a few individuals are likely to be affected, and no mitigation measures are necessary. However, general mitigation measures should apply.

Zone E **Grassy plains east of Obib** **Conservation Rating 3**	It is not possible to assess the status of the rare species found in this zone, because it is data deficient. However, it is known to have a restricted distribution and must be regarded as a conservation concern. Control of unnecessary tracks, turning points and collateral damage is of the utmost importance. The finer details of the route should take into account the higher diversity on the foot slopes and koppies. Final turning points should be manoeuvred to avoid them.

Vehicles will do by far the greatest damage to vegetation during the construction phase. In order to minimize disturbance, routes and turning points should be identified and demarcated before construction activities commence along each section and the making of new tracks due to corrugations or any other excuses should be strictly prohibited. Offenders should be subject to penalties.

Summary

VEGETATION DESTRUCTION	
Description	Damage to or destruction of vegetation mainly as a result of uncontrolled construction activities.
Extent	• Local
Duration	• Long term
Intensity	• High
Probability	• Certain
Mitigation	• Strict control of activities • Penalty clauses in EMP • Tracks and turning point areas identified before construction starts. • A knowledgeable person should be present to identify area of greater plant diversity so that they may be avoided.
Significance before mitigation	• High
Significance after mitigation	• Moderate to low
Summary	Impact on vegetation will be the highest in the coastal plains and hummocks closest to Uubvlei. If construction activities are controlled, then vegetation destruction can be successfully limited, and no plant rescue operations will be needed. Re-colonisation may be expected if damage is limited.

7.3.6 Destruction of or damage to archaeological and paeleontological records

Community and stakeholder concerns

Archaeology in the Sperrgebiet is extremely rich. Most management documents published for the area have stressed the importance of assessing potential damage to archaeological sites in the study area. Stakeholders such as Namdeb have stressed the need for such an assessment during this study.

A concern further exists that some of the fossil sites in the area will be damaged during construction.

Discussion

Archaeological sites were located during the EIA for the Site D power lines, and during this study. These, together with all previous sties located during past investigations, are shown on Figure 6-13.

Archaeology is the reconstruction of the past based on the physical remains of that past. For this reason the slightest disturbance to an archaeological site can cause significant damage. Not only is the physical integrity of the material evidence, for instance a stone tool such as a hand axe, of importance, but also the context in which it has been found. This makes them highly sensitive to any form of disturbance.

The process of construction, operation and maintenance and decommissioning of the power lines and construction camps would put the archaeological record at risk.

The impact concerned would be in the form of considerable surface and subsurface disturbance, which would either physically destroy the archaeological evidence or remove it from its original context, thus robbing it of its scientific value.

Of the total 21 sites discovered, four are of particular value, and should be preserved.

Since the power lines will cross overhead, and tracks can be navigated around sensitive areas, it is recommended that the archaeological sties to be preserved be marked off and fenced in before construction starts. Depending on the exact alignment north of the Orange River crossing and its distance from the archaeological sites in this area, they can either be marked off and fenced in or studied and removed before construction starts.

None of the proposed routes are fatally flawed from an archaeological aspect.

As shown on Figure 6-1, there are three fossil sites affected by the power line. The archaeologist discussed these sites with Mr R. Spaggiari, the Namdeb Exploration manager, who has extensive experience of the fossil sites of the southern Sperrgebiet. It was concluded that, in spite of being of considerable scientific interest, these sites are of such a nature both as far as extent and content were concerned that they could indeed be crossed by the power line, provided that collateral damage was limited to the construction corridor.

Summary

DAMAGE TO ARCHAEOLOGICAL AND PAELEONOLOGICAL RECORD	
Description	• Crosses four and potentially another seven valuable archaeological sites
Extent	• Local
Duration	• Permanent
Intensity	• High
Probability	• Certain
Mitigation	• Finally identify and fence off sites before construction starts • For the sites north of the Orange River, confirm sites when final route is selected. Then the decision should be made whether to remove or fence them off. • Construction activities must remain inside the designated area. • Ensure strict discipline to restrict construction activities
Significance before mitigation	• High
Significance after mitigation	• Low
Summary	• The archaeological sites of value found along the proposed power lines can be protected without having to reroute the power lines, making none of the routes fatally flawed from an archaeological perspective.

7.3.7 Further details of route sections

This section provides notes on environmental, economic and technical aspects for each of the route sections considered.

Uubvlei to Schakalberg (BP35) via Dippenaarskop (Alternative 1C, direct route)	Uubvlei to Schakalberg via Swartbult (Alternative 1A, indirect route)
• Dunes and sand at Dippenaarskop may present construction challenges. • Vegetation slightly more diverse than along indirect route. • Crosses 40km of pristine land. • Total distance: 40km • Strict control is of utmost importance during construction –vegetation is sensitive along this section. • Has two bend points	• Unchallenging terrain technically • Vegetation less diverse than the direct route • Crosses 30km of pristine land. (Follows the existing 66kv line for the 1st 16km). • Total distance: 46km • Crosses an extensive exposed fossil site/mini-escarpment, but can be traversed, provided that activities are restricted to one corridor. • Strict control is of utmost importance during construction –vegetation is sensitive along this section. • Has four bend points • The detour of this route via the existing 400kv route (1B) is not recommended because it traverses an even longer stretch of pristine land, i.e. 32km)

Schakalberg (BP35) to Obib (Alternative 1E)

- Apart from some smaller challenges requiring slight route deviations, there are no fatal flaws along this route.
- Z3, Z6 cut through the foot slopes of the Schakalberg (foot slopes should be avoided)
- Crosses a large fossil site (may be traversed, provided disturbance is minimised)
- Runs over a rocky hill at Z9 (should be avoided)
- Crosses a large moving dune at Z10.
- It is recommended to navigate the entire Z6-Z7 leg to avoid these features.
- Some rocky ridges and lower mountain slopes are affected between Z7 and Z8. They should be avoided, by navigating the route away from these features with an additional bend point.

This section crosses 40km of pristine land and has 4 bend points.

Swartbult to Northbank (Alternative 2)

- From Swartbult to 66-3, the route follows the existing 66kV line i.e. already disturbed terrain (12km in length)
- From 66-3, two options have been presented to skirt the GP Pan, fossil site and archaeological sites (Alternative 2 A, and B). The uncertainty of where diamond deposits lie in this area calls for further exploration. Namdeb should subsequently confirm where the diamond deposits lie, followed by a joint decision on the where the power lines will run. Only then can the archaeological sites be finally confirmed and recommendations made.

7.4 Conclusion

Overall, there are no fatal flaws along any of the proposed routes or their detours. As long as the "footprint" of the power lines are reduced to the minimum through close supervision of the construction process, and fine-tuned to avoid rocky outcrops, the disturbance will affect only a thin linear strip. To achieve a limited footprint, strict control and monitoring measures are necessary during construction.

The indirect route to Schakalberg, that is the one via Swartbult (Alternative 1A) is preferred above the direct route via Dippenaarskop (1C) for the following reasons:

- The route will follow existing disturbed terrain for 16km of the way. It traverses 10km less pristine land than the direct route.
- The zone through which these two alternatives pass near Uubvlei is the most sensitive environmentally, with a conservation rating of 4. By aligning the power lines with the existing 66kV power line, one would greatly reduce disturbances in this sensitive habitat.
- Since construction will in any case be happening along the indirect route up to Swartbult for the construction of the route to South Africa, it makes sense to combine all construction activities and subsequent damage to one corridor.
- Although both routes are acceptable, the indirect route is slightly preferred above the direct one from a vegetation aspect, because plant diversity is higher there.
- The specialists drove along both routes and are of the opinion that construction access will be difficult along the direct route, because of the high and unstable dunes occurring in the Dippenaarskop area.

Technical and financial considerations will also influence the final analysis of the preferred route. By opting for the relatively modest environmental benefits of Alternative 1A, NamPower will have to spend an estimated N$ 6 million to build the additional 6km of power lines, and will experience greater technical challenges[2] to align them in one corridor. These additional costs are probably not warranted to avoid the relatively small additional environmental impact of Alternative 1C. Therefore, although Alternative 1A is favoured environmentally, the Consultant will also support Alternative 1C, provided that construction activities harm the area as little as possible.

[2] One of the 400kV power lines will only be built for the second phase of the project. Building this power line with two existing power lines (i.e. the two 400kV power lines to be constructed for Phase 1 of the project) already flanking it poses technical and safety challenges.

In the stretch from Schakalberg to Obib, a number of small changes are recommended to avoid high ground, dunes, rocky outcrops etc.

The exact route taken around the GP Plan north of the Orange River can only be determined once Namdeb has confirmed the location of the diamond reserves. Confirmation should then be obtained on which archaeological sites would be affected and how they should be dealt with before construction commences.

8 Conclusions and Recommendations

8.1 Introduction

This study is an Environmental Impact Assessment of power lines leading from the proposed Kudu Gas CCGT Power Station to be built near Oranjemund, Namibia. NamPower previous considered the construction of the power station at Site D, East of Oranjemund. It has been decided to also consider a scenario of building the power station at Uubvlei, an alternative site some 24 km North of Oranjemund. The particular power lines in question are:

a) A proposed 220 kV power line from Uublvei to Oranjemond substation;
b) a proposed 400 kV power line from Uubvlei to connect to the approved and constructed alignment of the 400 kV power line from Kokerboom substation near Keetmanshoop to the Obib substation supplying Skorpion Mine; and
c) two proposed 400 kV power lines from Uubvlei to a river crossing north of the Oranjemond substation in South Africa.

8.2 Route evaluation and environmental assessment

Initially a number of alternative routes were considered which were refined following a helicopter survey of the routes. The route alternatives considered during the EIA are shown on Figure 3-2.

The following key issues were considered:

- **Visual Impact**: The visual impact will be high in the Schakalberg – Obib area with its exceptional wilderness qualities. However, the route has been optimised to reduce visual impact by keeping to valley bottoms and avoiding outcrops and higher ground. Visual impact will also be high at the Orange River crossing. The new power lines will follow the existing crossing point of the 66kV line. The visual impact at this point, while negative from an aesthetic point of view, is also a 'blessing in disguise' from a bird collusion and aviation perspective. From the latter point of view, it is better to have all the lines together.

- **Potential diamond lock-up**: The route to South Africa crosses an old channel of the Orange River. Initial drilling has shown that there may be some diamond reserves in this area. Confirmation needs to be obtained after further exploration work has been completed, scheduled for 2005. The route in this area can only be finalised once the diamond reserves have been located. Because of the uncertainly of this matter, impact significance is considered high.

- **Destruction of vegetation during construction and maintenance**: 5 Habitats with different compositions of vegetation have been identified. The botanist is of the opinion that unwanted impacts to vegetation can be avoided by ensuring strict control of construction activities to ensure a limited footprint. The habitat surrounding Uubvlei is the most sensitive, harbouring many endemic species. In this area, strict control during construction will be crucial. With mitigation, the impact significance will be low.

- **Impacts on fauna**: The fauna of the study area may be affected by poaching and habitat destruction during construction. These impacts can be limited through careful

management and monitoring of the construction team. With mitigation, the impact significance is low.

- **Damage to archaeology**: Four valuable archaeological sites were found along the routes during this study. They can be protected by fencing them off before construction starts. Impact on archaeological sites will be low after mitigation.

8.3 Final Recommendations

None of the routes considered during this study are fatally flawed. However, the indirect route to Schakalberg is environmentally preferred above the direct one, since the former follows an existing 66kV power line. In addition, the line to South Africa will be constructed along this section in any case. Remaining in one construction corridor will reduce disturbance to pristine habitat, which is incidentally the most sensitive where these lines originate from Uubvlei. The direct route is also likely to be difficult to access during construction. The consultant is aware that the indirect route will be considerably more expensive and technically more challenging to build than the direct one. A decision to opt for the direct route will be supported on condition that environmental disturbance be limited as far as possible.

Apart from avoiding outcrops and higher ground, the one most important factor to ensure limited impact in this pristine and sensitive desert environment, is to limit the footprint made along the routes during construction. Therefore, the Consultant wishes to stress the importance of proper environmental management at the time of construction. This project will be implemented in a pristine wilderness area that will soon be proclaimed a national park. Ecological and archaeological impacts can only be limited with very strict control during construction. To achieve this goal it is required that NamPower appoints a suitable monitor to be present in the area while construction proceeds. Without such an arrangement, the consultant believes that construction impacts will be very difficult to control, and unacceptable damage is likely to occur.

The original EMP, which now has to be updated for this study, recommends no construction camps along the routes. Access is to be taken from either Obib or Oranjemund. Given the distance of the power line routes, and the difficulty of accessing the project area, the practicality of the recommendation is questioned. Identifying 2 camps along the route at less sensitive locations might be more practical. Having to drive to and fro along the access tracks each day to reach the construction areas is likely to cause more damage than allowing some sites along the way. These issues should be finalised in the EMP.

Monitoring and decommissioning plans should be included in the Environmental Management Plan. They should *inter alia* give attention to monitoring of bird impacts and the fate of the power lines once they have become redundant. Monitoring efforts are not always practical, but could be done in conjunction with the Oranjemund community and Namdeb. Limits of acceptable change should be set as a guideline for tracking changes during operation. Monitoring details will be fully covered in the EMP.

A final route for the section North of the Orange River can only be confirmed once the location of the diamond reserves in this area are known. In order for NamPower to timeously construct the 220kV power line that is needed to supply power to the Uubvlei site, Namdeb needs to resolve this issue by conducting the additional surveys as soon as possible. Once agreement on the final route has been reached, the archaeologist should be consulted to confirm affected archaeological sites and how they should be protected.

9 References

Alonso, J. A., Alonso, J. C., 1999. Mitigation of bird collisions with transmission lines through groundwire marking. In: Ferrer M and Janss F E (eds), Birds and power lines, pp113 – 124, Quercus, Madrid, Spain.

Anderson, M.D & Kolberg, H, 1997 – 2004. Waterbird Surveys: Orange River. Unpublished data.

Anderson, M.D., 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

Anderson, M.D., Kolberg, H., Anderson, P.C., Dini, J., Abrahams, A. 2003. Waterbird populations at the Orange River mouth from 1980-2001: a re-assessment of its Ramsar status. Ostrich 74(3&4): 159-172.

Avery, G. 1985. Late Holocene Use Of Penguin Skins: Evidence From A Coastal Shell Midden At Steenbras Bay, Luederitz Peninsula, South West Africa – Namibia, Ann. S. Afr. Mus. 96(3): 55-65.

Barnes, K.N., (ed.) 1998. The Important Bird Areas of southern Africa. Pp 109-111. BirdLife South Africa, Johannesburg.

Barnes, K.N., (ed.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Barnard P (ed) 1998. Biological diversity in Namibia: a country study. Windhoek: Namibian national Biodiversity Task Force.

Birdlife International. 2000. Threatened Bird of the World. Lynx Edicions and BirdLife International. Barcelona and Cambridge.

Burke, A. 1998. Vegetation in the Oranjemund area. Appendix 2.G in: Nampower (1998). Kudu Gas Power Project Preliminary Environmental Assessment.

Burke, A. 1999. Floral Specialist Contribution to the Environmental Evaluation of Route Options for the 400 kV Power line linking the Kokerboom Substation, Skorpion Zinc Mine and the Kudu Gas Power plant. Unpublished Report for Walmsley Environmental Consultants.

Corvinus, G. 1977. Paeleontological And Archaeological Investigations In The Lower Orange Valley From Arrisdrift To Obib. Paeleocology Of Africa And The Surrounding Islands 10/11: 75-91.

Corvinus, G. 1983. The Raised Beaches Of The West Coast Of South West Africa/Namibia: An Interpretation Of Their Archaeological And Paeleontological Data: Munich: C.H. Beck.

Craven, P. (Ed.) 1999. Checklist of Namibian Plant Species. SABONET Report No. 7. SABONET, Windhoek.

Cruz-Uribe, K. And Klein, R.G. 1983. Faunal Remains From Some Middle And Later Stone Age Archaeological Sites In South West Africa. Journal Swa Wiss. Gesellschaft 37: 91-114.

CSIR (2004) Environmental Impact Assessment. Proposed Kudu CCGT Power Plant at Oranjemund. *CSIR Report ENV-S-C 2004-073*. Stellenbosch. 207pp, with Appendices. Prepared for Namibia Power Corporation (Pty) Ltd.

Cunningham, P. 2005. Personal Communication About The Unresolved Status Of Pale And Dark Colour Morphs Of *Bitis Schneideri*.

Davis, O. And Walsh, R.C. 1955. Raised Beaches And Associated Stone Age Material In Namaqualand. S. Afr. J. Sci. 51: 277-282.

Giess, W. (1971) A preliminary vegetation map of Namibia. Namibia Scientific Society

Government of the Republic of Namibia. 1990. The Constitution of the Republic of Namibia, Act 1 of 1990. Government Gazette. Windhoek, Namibia

Government of the Republic of Namibia. 1999. Environmental Management Bill of 1999. Unpublished. Windhoek, Namibia

Government of the Republic of Namibia. 1992. Labour Act of 1992. Government Gazette. Windhoek, Namibia

Government of the Republic of Namibia. 1999. Diamond Act, Act 13 of 1999. Government Gazette. Windhoek, Namibia

Griffin, M. 1995. Annotated Checklist And Conservation Status Of Mammals, Reptiles And Amphibians Of The Sperrgebiet, Southern Namib Desert, Namibia. Unpublished Report Held By Namdeb: Sperrgebiet Specialist Study.

Griffin, M. 1999. Checklist And Provisional National Conservation Status Of Amphibians, Reptiles And Mammals Known Or Expected To Occur In Namibia. Unpublished Manuscript, Ministry Of Environment And Tourism.

Griffin, M. 1998. Expert Opinion On Mammals, Reptiles And Amphibians. Appendix 2.H In: Nampower (1998). Kudu Gas Power Project Preliminary Environmental Assessment.

Hart, T. and Halcett, D. 1999. An Assessment Of Recent Archaeological Baseline Surveys In The Sperrgebiet. Internal Report Prepared For Namdeb By The Archaeology Contracts Office Of The University Of Cape Town.

Hofmann, Undated. 1:500 000 Map Of The Sperrgebiet, Showing Features, Names And Routes, Believed To Date From The 1930s. Original In Luederitz Museum.

Hobbs, J.C.A., & Ledger J.A., 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986.

Hobbs, J.C.A., & Ledger J.A., 1986b. Powerlines, Birdlife and the Golden Mean. Fauna and Flora 44:23-27.

Kruger, R., Van Rooyen, C.S., 1998. Evaluating the risk that existing powerlines pose to large raptors by using risk assessment methodology: the Molopo Case Study. 5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.

Kruger, R., 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. M. Phil. Mini-thesis. University of the Orange Free State. Bloemfontein. South Africa.

Ledger, J., 1983. Guidelines for Dealing with Bird Problems of Transmission lines and Towers. Escom Test and Research Division Technical Note TRR/N83/005.

Ledger, J.A., Annegarn H.J., 1981. Electrocution Hazards to the Cape Vulture *(Gyps coprotheres)* in South Africa. Biological Conservation 20:15-24.

Ledger, J.A., 1984. Engineering Solutions to the Problem of Vulture Electrocutions on Electricity Towers. The Certificated Engineer 57:92-95.

Ledger, J.A., Hobbs J.C.A., Smith T.V., 1992. Avian Interactions with Utility Structures: Southern African Experiences. Proceedings of the International Workshop on Avian Interactions with Utility Structures, Miami, Florida, 13-15 September 1992. Electric Power Research Institute.

Marais, E. 1998. Entomological profile of the Oranjemund area, and considerations for selecting a site for the Kudu Power Station. Appendix 2.I in: Nampower (1998). Kudu Gas Power Project Preliminary Environmental Assessment.

McCann, K., Morrison, K., Byers, A., Miller, P. & Friedman, Y. (eds). 2001. Population and Habitat Viability Assessment for the Blue Crane *(Anthropoides paradiseus).* Conservation Breeding Specialist Group (SA), Endangered Wildlife Trust, Johannesburg.

Mannheimer, C.A. 2004. EIA of proposed power lines from the Kudu Gas Power Station in Oranjemund. Botanical Assessment. For NamPower. Appendix.

Midwest Today, www.midtod.com/voltage. 1996. Studies Link: Electromagnetic Fields (EMFs) to Illness. Do High Voltage Power Lines Cause Cancer by Neal Lawrence. United States of America.

Ministry of Environment and Tourism. 1995. Namibia's Environmental Awareness Policy for Sustainable Development and Environmental Conversation. Windhoek, Namibia.

Namibia Development Consultants (Ndc), Karas Regional Development Plan, National Planning Commission, Grn, 2001.

Namdeb 2003. Wet Overburden Mining System Final Environmental Impact Assessment Report. Pisces Environmental Services (Pty) Ltd., Anchor Environmental Consultants CC.

Nampower (Undated) Siting Considerations For The Kudu Ccgt Power Plant In Two Phases Of 800 Mw Each. Internal Memorandum.

Noli, D. 1989. An Archaeological Investigation Of The Koichab River Region Of The South-Western Namib Desert, Centred On The Activities Of Holocene Hunter-Gatherers. Unpublished M. A. Thesis, University Of Cape Town.

Noli, D. 1995. Reaching For The Past. Ewi Namdeb 4th Quarter 1995: 16-21.

Noli, D. 1998. Archaeological Specialist Study: Oranjemund Link Road Eia. Unpublished Report, Prepared For Enviroscience, Windhoek.

Noli, D. 2003. Expansion Sites Archaeology: The Archaeology Of The Land-Based Namdeb Production Expansion Study (Npes) Sites, Conducted In The Sperrgebiet In October And November 2002. Unpublished Internal Report, Prepared For Namdeb, Oranjemund.

Noli, D. 2004. EIA of proposed power lines from the Kudu Gas Power Station in Oranjemund. Archaeological Assessment. Prepared for NamPower. Appendix.

Pallett, J. (Ed.) (1995) The Sperrgebiet. Namibia's Least Known Wilderness. An Environmental Profile Of The Sperrgebiet Or Diamond Area 1, In Southern-Western Namibia. Drfn And Namdeb, Windhoek, Namibia.

Pallett, J. 2004. EIA of the proposed power lines from the Kudu Gas Power Plant in Oranjemund. Terrestrial Ecological Assessment. Prepared for NamPower. Appendix.

Ramsar. 1971. Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention on Wetlands).

Rudner, J. 1968. Strandloper Pottery From South And South West Africa. Ann. S. Afr. Mus. 49: 441-663

Rudner, J. And Grattan-Bellew, P. 1964. Archaeological Sites Along The Southern Coast Of South West Africa. South African Journal Of Science 60: 67-79.

Sprigade, P. And Heine, F. 1911. Karte Des Gebietes Laengs Der Luederitzbahn Zwischen Luederitzbuch Und Schakalskuppe (1: 200 000), Nach Aufnahmen Des Regierungsgeologen Dr. Paul Range. Mitteilnungen Aus Den Deutschen Schutzgebieten 24.

Sprigade, P. And Lotz, H. 1913. Karte Des Sperrgebietes Deutsch Sudwest Afrikas In Zehn Blaettern (1: 100 000). Berlin: Deutsche Diamantengesellschaft.

Sprigade, P. And Moisel, M. 1904. Kriegskarte Von Deutsch-Suedwestafrika (1: 800 000). Berlin: Dietrich Reimer.

United Nations. 1997. Convention on Biological Diversity.

Van Rooyen, C.S., Ledger, J.A., 1999. Birds and utility structures: Developments in southern Africa. Pp 205-230 in Ferrer, M. & G..F.M. Janns. (eds.) Birds and Powerlines. Quercus, Madrid, Spain.

Simmons, R.E., Brown, C.J., Williams, A.J. (In prep.) Birds to watch in Namibia: a red list. National Biodiversity Programme. Ministry of Environment and Tourism. Namibia.

Van Rooyen, C.S., Taylor, P.V., 1999. Bird Streamers as probable cause of electrocutions in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina

Van Rooyen, C.S., 1998. Raptor mortality on powerlines in South Africa. 5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.

Van Rooyen, C.S., 1999**.** An overview of the Eskom-EWT Strategic Partnership in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999, Charleston, South Carolina.

Van Rooyen, C.S., 2000. An overview of Vulture Electrocutions in South Africa. Vulture News 43: 5-22. Vulture Study Group, Johannesburg, South Africa.

Van Rooyen, C.S., 2003. Mitigation Programme for Avian Collisions with Eskom Transmission Lines. Unpublished Progress Report, September 2003. Endangered Wildlife Trust, Johannesburg, South Africa.

Van Rooyen, C.S., 2004a. The Management of Wildlife Interactions with overhead lines. In: The Fundamentals and practice of Overhead Line Maintenance (132 kV and above), pp217-245. Eskom Technology, Services International, Johannesburg 2004.

Van Rooyen, C.S., 2004b. Investigations into vulture electrocutions on the Edwardsdam-Mareetsane 88 kV feeder, Unpublished Report, Endangered Wildlife Trust, Johannesburg, South Africa.

Van Rooyen, C.S., 2004c. Powerline Interaction Project: Progress Report: January - June 2004. Unpublished Report. Endangered Wildlife Trust, Johannesburg, South Africa.

Van Rooyen. C.S. 2004. EIA of the proposed power lines from the Kudu Gas Power Station in Oranjemund. Bird Impact Assessment. For NamPower. Appendix.

Verdoorn, G.H., 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132 kV powerlines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. 2nd International Conference on Raptors: 2-5 October 1996. Urbino, Italy.

Walmsley Environmental Consultants (WEC) (1998). Preliminary Environmental Assessment of the Proposed Kudu Gas Power plant at Oranjemund, Namibia. Nampower.

Walmsley Environmental Consultants (WEC). (1998). Environmental Evaluation Of The 220 kV Power Line Route Option To Link The New Sub-Station Near Oranjemund Namibia, With The South African Grid At The Oranjemond Substation. Nampower.

Walmsley Environmental Consultants (WEC). (1999). Environmental Evaluation Of The 400 kV Power Line Route To Link Kokerboom Sub-Station, Skorpion Zinc Mine And The Proposed Kudu Gas Power Plant. Phase 1 And 2 Reports. Nampower.

Walmsley Environmental Consultants. (WEC).(2001). The Sperrgebiet Land Use Plan. Report W309/1. Ministry Of Environment And Tourism, Ministry Of Lands, Resettlement And Rehabilitation, Ministry Of Mines And Energy.

Wendt, W.E. 1972. Preliminary Report On An Archaeological Research Programme In South West Africa. Cimbebasia (B) 2: 1-61.

Wendt, W.E. 1975a. Ein Rekonstructionsversuch Der Besiedlungsgeschichte Des Westlichen Gross-Namalandes Seit Dem 15. Jahrhundert. Journal Swa Wiss. Gesellschaft 29:23-56.

Wendt, W.E. 1975b. Hinweise Auf Das Fruehere Vorkommen Einiger Grosswildarten Im Westlichen Gross-Namaland.

Wendt, W.E. 1976. 'Art Mobilier' From The Apollo 11 Cave, South West Africa's Oldest Dated Works Of Art. S. Afr. Archaeol. Bull. 31: 5-11

Wendt, W.E. 1978. Felsgravierungen Im Suedlichen Suedwestafrika. Journal Swa Wiss. Gesellschaft 32: 7-68.

Wendt, W.E. 1980. Fragmente Aus Der Ur- Und Fruehgeschichte Des Westlichen Gross-Namalandes. Afrikanischer Heimatkalender (1980): 33-50

Wendt, W.E. 1981. Die Letzten Sammler Und Jaeger Aus Der Suedlichen Namib. Afrikanischer Heimatkalender (1981): 45-62

Werz, B.E.J.S. & Flemming, N.C., 2001. Discovery In Table Bay Of The Oldest Handaxes Yet Found Underwater Demonstrates Preservation Of Hominid Artifacts On The Continental Shelf. South African Journal Of Science 97, 183-185.

Wessels, D.C.J. 1994. Aspects of "Sperrgebiet" lichens. Unpublished report held by Namdeb. Sperrgebiet Specialist Studies: Lichens.

Williams, A. J. Velasquez, C., 1997. Greater Flamingo *Phoenicopterus rubber*. In: The atlas of southern African birds, Volume 1: Non-passerines, Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). Bird Life South Africa, Johannesburg, pp112 - 113.

Williamson, C., 1997. Preliminary account of the Floristic Tones of the Sperrgebiet. (Protected Diamond Area) in South-west of Namibia

ENVIRONMENTAL IMPACT ASSESSMENT OF THE POWER LINES FROM THE KUDU GAS POWER STATION (UUBVLEI SITE) TO ORANJEMOND AND OBIB RESPECTIVELY

Final

Route Evaluation and

Environmental Impact Report

Volume 2

NamPower

Prepared by:

Enviro Dynamics (Pty) Ltd
P O Box 20837
Windhoek
Namibia
Tel: 264 61 223336
Fax: 264 61 240309
E-mail:
envirod@africaonline.com.na

June 2005

LIST OF APPENDICES:

APPENDIX 1A

MINUTES OF THE PUBLIC CONSULTATION MEETING AND FEEDBACK FROM STAKEHOLDERS

PUBLIC CONSULTATION MEETING

UPDATING OF THE EIA AND EMP FOR THE PROPOSED POWER LINES FROM KUDU IN THE VICINITY OF ORANJEMUND

Date: **Thursday, 31 March 2005**

Venue: School Auditorium, Oranjemund

Present: Mr. J. Langford
Ms. M. Van der Merwe
Mr. D. Mbidi
Mr. G. Kegge
Dr. P. Tarr
Ms. S. Van Zyl
See attached attendance list

MINUTES

1. OPENING & INTRODUCTION

After Dr Peter Tarr had introduced the visiting team, Ms Margaret van der Merwe provided an introduction to the evening and the purpose of the visit. She stressed the fact that NamPower is committed to solid public consultation and to hear the opinions of the Oranjemund community. (presentation attached).

2. PROJECT OVERVIEW

(i) Power Station

Technical presentation

Mr John Langford provided technical details of the proposed power station at Uubvlei (presentation attached).

Details of EIA

Mrs Stephanie van Zyl presented the proposed work plan and programme for the EIA study (presentation attached).

Issue identification

Mrs van Zyl showed the meeting the list of issues for the Site D EIA compiled by the public at the previous meeting. The meeting confirmed which issues were relevant for the Uubvlei study. The list was changed to reflect these issues (see the attached issues list).

(ii) Power Lines

Technical presentation

Mr Langford discussed the proposed power line routes originating from Uubvlei to the Obib and Oranjemond substations respectively (see attached map).

Details of EIA

Mrs Van Zyl discussed the approach and programme for the power lines EIA study (see attached presentation).

Issue Identification

Mrs Van Zyl continued to present the issues that were identified for the power line route alternatives leading from Site D at the previous public meeting. The meeting confirmed which issues were relevant for the Uubvlei study. The list was changed to reflect these issues (see the attached issues list).

4. CLOSING

Attendants informed the presenters that the Oranjemund community received their invitations to the meeting that same day. Ms van Zyl explained that the invitation was supposed to have reached the people via the mine-wide e-mail service some 2 weeks before. Mrs van Zyl extended her apologies for the late notification. Ms van der Merwe confirmed that NamPower would gladly hold another meeting, if need be, as long as it could be scheduled soon to avoid a delay in the programme. The attendants considered this possibility, and agreed that an additional public meeting would not be warranted. Previous public meetings advertised well in advance did not receive significantly greater support than this one. It was therefore decided that the one public meeting would suffice, on condition that the Councillor for that constituency agreed as such. Mrs van Zyl agreed to contact the relevant Councillor the following day. It was further agreed that the minutes of the meeting would be circulated via the mine-wide service and people invited to comment.

Finally, Ms van der Merwe closed the meeting by thanking all present for their time and by confirming NamPower's commitment to consider all inputs from the community.

The meeting adjourned at 20h30.

ISSUE IDENTIFICATION MATRIX: UUBVLEY TRANSMISSION LINES

1	Danger to Aviation – IKAO Standards (Uubvley site is preferred from an Aviation
2	Bird Issues - Nesting of new species - Tower design - Especially Birds of Pray
3	Access and security, including access control for maintenance, and security at construction site
4	Visibility/aesthetics (much less of an issue than for Site D, but should be considered from a tourism perspective; impact on wilderness qualities)
5	Corrosion
6	Construction Cost
8	Vegetation Transplant
9	Impact on animal and bird migration (during construction)
10	Waste Management
11	Archaeological Sites
12	Decommissioning
14	Accommodation during construction

ISSUE IDENTIFICATION MATRIX: UUBVLEY POWER STATION SITE

ISSUES RELATED TO THE OPERATION & MAINTENANCE PHASE

ISSUES	DESCRIPTION
Corrosion	Corrosion by spray due to proximity to the ocean
Noise	Sound ratings due to plant operation (much less of an issue than for Site D)
Abrasion	Abrasion by wind blown sand on pipework and structures
Visual Impact	Much less of an issue than for Site D, but needs to be considered
New Water Act	The implications of the new Water Act on the project
Normal Health and Safety Issues	
Risk/Emergencies	Risk of spills, seepage or leaks to Oranjemund well field & Ramsar site and Explosions
Proximity to Sperrgebiet	Proximity to the to-be proclaimed National Park and tourism area
Surf Zone	Operation in the high energy surf zone
Suspended Solids	Only an issue with use of sea water
Marine Ecosystems	Impact on marine environment
Air Quality	Impact on air quality (pollution)
Managing Construction Waste	The fate of construction waste
Processed chemicals released from system	Persistence of any biocide
Use of back-up fuel	
Impact of secondary industries on town	
Integrity of EIA process – depending on up- and downstream EIAs Integration	
Impact on town's viability – economic spin-offs	Tourism aquaculture industries

ISSUES RELATED TO THE CONSTRUCTION PHASE

ISSUES	**DESCRIPTION**
Corrosion	Corrosion by spray due to proximity to ocean
Abrasion	Abrasion by wind blown sand
Access-workforce/equipment	Difficulty of access for people and material, especially if the security fence remains in current position
Powerline Access	Finding a route for the powerline from the site
Surf Zone	Construction in the high energy surf zone
Road Safety	Increased traffic through town
Pipeline Access	Construction of discharge pipeline to the sea if ground water is used
Conservation Areas	Control to be imposed on conservation due to adjacent native park
Aesthetics – birds	Impact of noise and lights on birds
Terrestrial Habitat	Impact on vegetation and high valve animals and welland species
Services	Impact on normal town services – sewage, water reticulation, power, etc.
Safety/Security	Personal safety and security
Community Facilities	Impact of work force on hospitals, clinics, schools, police, fire, etc.
Social Integration	Mixing of permanent work force with temporary work force
Vegetation	Direct impact on existing vegetation
Marine Habitat	Direct impact on the marine habitat
Housing	Impact on the town's housing including end of phase impact
Managing Construction Waste	Hazardous waste & reportable environmental incidents
Departure of Construction Personnel on Completion	
Road Access of Plant Equipment	
HIV/Aids	
Poaching Gemsbok	
Impact on town's viability	

ISSUES RELATED TO THE DECOMMISSIONING PHASE

ISSUES	**DESCRIPTION**
Impact on town's viability	
Physical rehabilitation of site – other uses?	
Financial Contributions – eg. Trust fund	
Closure Plan	
Decommissioning impacts on other facilities elsewhere in the region	

ADDITIONAL ISSUES RAISED FOR UUBVLEI

Reasons for shifting to Uubvlei

Some sectors of the Oranjemund community represented at the meeting questioned the reason for the possible shift from Site D to Uubvlei especially in the light of the promulgation of Oranjemund as a municipality in future. To many people, the prospect of the power station at Site D was appealing. However, other persons at the meeting noted their opposition to the power station being located at Site D, because of concerns around noise, visual impacts and pollution. This opposition was submitted in the form of a petition and this petition had been recorded in the EIA report. In response, NamPower explained that the decision to abandon Site D and move to Uubvlei has not been taken yet, and even if Uubvlei is selected as the preferred alternative to Site D, public opposition will likely not be the main justification. Technical and economic considerations would also be considered.

The meeting noted that opposition to Site D was not unanimous within the Oranjemund community.

Security/Access Control

Members at the meeting raised security and access as issues that need additional consultation and consideration should Uubvlei be chosen as the site for the power station. NamPower confirmed that these issues were high on their agenda and that they would be fully considered. The MD of Namdeb similarly gave the assurance that Namdeb interests would need to be protected and that a mutually-acceptable solution would be sought.

Visual and noise impacts

There was general agreement that locating the power station at the Uubvlei site would eliminate the problem of noise and visual impacts for residents at Oranjemund. However, the meeting noted the need to ensure that noise levels inside the plant conform to international standards so that the health of workers is not jeopardized. Moreover, is was noted that the plant should blend in as much as possible with the surroundings (e.g. through appropriate paint colour), though it was acknowledged that Uubvlei site is in any case an industrial site and will thus not be part of a future tourism route.

Medical and other facilities

It seems like the medical fraternity at Oranjemund is welcoming the additional work that will be created by the Kudu Project.

Biophysical impacts

A number of people at the meeting suggested that the possible move to Uubvlei would require new studies relating to the impacts on flora and fauna, as the surroundings at Uubvlei are somewhat different to those at Site D. NamPower confirmed that such studies were already envisaged in the TOR and would be done. The same was mentioned regarding waste management.

Perceptions regarding re-use of Uubvlei accommodation

The meeting noted that the issue of using the hostel at Uubvlei is sensitive and thus needs careful consideration. Namdeb is gradually phasing out the use of this facility for various reasons, one of which is its apparent declining suitability as decent accommodation. Thus, the project must be sure that the facilities are of an appropriate standard to house workers. This point was noted by the consultants, and it was mentioned that this issue is in any case reflected in the Terms of Reference for the study.

Aviation:

The Oranjemund Flying Club stressed three points during the meeting:

1. They strongly support a move of the power station from the original "Site D" to the Uubvlei site. They believe the Uubvlei location will pose substantially lower risk to aircraft than Site D. The major risks to aircraft at Site D would be: smoke plume reducing visibility, power lines in close proximity of airfield and the height of the smoke stacks posing a risk to aircraft approaching FYOG for the north-west. These risks would be aggravated in poor visibility and at night. They believe these risks would be virtually eliminated by moving to the Uubvlei site.
2. All HT power lines crossing the Orange River must be at the same location. The deep valley of the Orange River results in high hanging power lines. Minimizing crossing points over the Orange River is of critical importance. All new power lines must cross at Oranjemond substation where the current 66kV line crosses.
3. As with the HT lines crossing the Orange River, new HT lines must follow existing power lines in the desert as far as possible. Various HT lines pose a risk to low level approaching aircraft from the north. Minimizing the number of HT crossing point will mitigate this risk

Access and Transport

Some people in the meeting wanted to know which roads would be used to the site. It was mentioned that the existing access road to Uubvley from Oranjemund would probably be adequate, but that this would depend on other access and security arrangements. The issues of road access and transport of materials, goods and people to and from site would be addressed in the EIA.

ADDITIONAL EIA STUDIES FOR THE KUDU GAS TO POWER PROJECT

CONSULTATION MEETING: ORANJEMUND
31 MARCH 2005 AT 17H30

ATTENDANCE LIST

NAME	ORGANISATION	TELEPHONE	FAX	POSTAL ADDRESS	E-MAIL ADDRESS
D. Duvenhage	**Namdeb**	063-235331	063-235155	P.O. Box 35, ORM	Dewald.duvenhage@namdeb.com
R. Duvenhage	**Namdeb**	063-235744	063-235719	P.O. Box 35, ORM	Riana.duvenhage@namdeb.com
T. De Klerk	**Namdeb**	063-236736		P.O. Box 35, ORM	Tobie.deklerk@namdeb.com
A.C. Darne	**Namdeb**	063-237459	063-237521	P.O. Box 35, ORM	Andrew.darne@namdeb.com
T. Conry	**NCCI**	063-232551	063-232551	P.O. Box 1182, ORM	elodo@mweb.com.na
Anca Burger	**Namdeb**	063-2335807	063-235719	P.O. box 604, ORM	Anca.burger@namdeb.com
Wicus Burger	**Namdeb & ORM Flying Club**	063-238650	063-238603	P.O. Box 604, ORM	Wicus.burger@namdeb.com

NAME	ORGANISATION	TELEPHONE	FAX	POSTAL ADDRESS	E-MAIL ADDRESS
E.S. Iita	**MUN**	063-235763 0811229435	063-235283	P.O. Box 985, ORM	Eliphas.iita@namdeb.com
D. Popyeinawa	**MUN**	063-235237 0812422613	063-235283	P.O. Box 222, ORM	popyeinawad@namdeb.com
S. Haulofu	**MUN**	0811284565		P.O. Box 332, ORM	haulofus@namdeb.com
A.N. Gully Muteka	**Namdeb**	063-233692 08128900388	063-235719	P.O. Box 1144, ORM	Gully.muteka@namdeb.com
A. Shanyenge	**Namdeb**	063-235919	063-235719	P.O. Box 1844, ORM	Abisai.shanyenge@namdeb.com
R. Burger	**Namdeb**	063-235475	063-235719	P.O. Box 1619, ORM	Riaan.burger@namdeb.com
C. Burger	**Namdeb**	0834544690	063-232301	P.O. Box 1703, ORM	cburger@mweb.com.na info@omd.chcafrica.com
L. Mauritius	**MUN**	063-235922 0812776888		P.O. Box 320, ORM	
J.K. Kandundu	**Namdeb**	0812540215	063-238359	P.O. Box 149, ORM	Joey.kandundu@namdeb.com
H.A. Cokes Hindjou	**MUN**	063-235952 0812426754	063-238359	P.O. Box 1169, ORM	Heinrich.hindjou@namdeb.com
R. Burrell	**Namdeb**	063-235322	063-235460	P.O. Box 253, ORM	Bob.burrell@namdeb.com

From: Golder, Wally [wally.golder@namdeb.com]
Sent: Thursday, April 07, 2005 1:00 PM
To: alynsia@uda.com.na
Subject: Existing Power Lines

Hi Alynsia,

I see on maps provided that the new power lines will be installed on the same route as that of our existing 66kV power line which is fed from the RSA.

I am under the impression that we, Namdeb will still be receiving our power via this line and not Kudu.

Please advise.

Regards

Wally Golder
Chief Technician
ELECTRICAL SECTION
NAMDEB (PTY) LIMITED
Tel: 09264 (63) 235069
Fax: 09264 (63) 235123
e-mail: wally.golder@namdeb.com

Our Motto: Consider It Done
CARE • **I**NTEGRITY • **T**EAMWORK • **E**XCELLENCE

From: Burger, Wicus [wicus.burger@namdeb.com]
Sent: Wednesday, April 06, 2005 10:22 AM
To: Alynsia Platt
Subject: FW: NAMPOWER UUBVLEI POWERSTATION AND POWERLINES
fyi

Regards,
Wicus Burger
+264 63 238650 (tel)
+264 81 122 9438 (cel)
+264 63 238603 (fax)
-----Original Message-----
From: Burger, Wicus
Sent: Monday, April 04, 2005 4:37 PM
To: 'Christian Sell'
Cc: Schoeman, Stefan; Macmillan, David; Burger, Riaan; Wieland, Wulff-Dieter (Wulff); 'envirod@africaonline.com.na'; du Preez, Andre; Burger, Anca
Subject: RE: NAMPOWER UUBVLEI POWERSTATION AND POWERLINES

Best Jochi,

Feedback to Department of Civil Aviation:
On behalf of the Oranjemund Flying Club, kindly note the three points stressed during the NAMPOWER UUBVLEI POWERSTATION AND POWERLINES meeting:

1. We strongly support a move of the power station from the original “Site D” to the Uubvley site. We believe the Uubvley location will pose substantially lower risk to aircraft than Site D. The major risks to aircraft at Site D would be: smoke plume reducing visibility, power lines in close proximity of airfield and the height of the smoke stacks posing a risk to aircraft approaching FYOG for the north-west. These risks would be aggravated in poor visibility and at night. We believe these risks would be virtually eliminated by moving to the Uubvley site.
2. All HT power lines crossing the Orange River must be at the same location. The deep valley of the Orange River results in high hanging power lines. Minimizing crossing points over the Orange River is of critical importance. All new power lines must cross at Oranjemond substation where the current 66kV line crosses.
3. As with the HT lines crossing the Orange River, new HT lines must follow existing power lines in the desert as far as possible. Various HT lines pose a risk to low level approaching aircraft from the north. Minimizing the number of HT crossing point will mitigate this risk.

Regards,
Wicus Burger
On behalf of Oranjemund Flying Club

From: Goosen, Tony [tony.goosen@namdeb.com]
Sent: Thursday, March 31, 2005 9:08 AM
To: Enviro Dynamics
Cc: alynsia@uda.com.na
Subject: RE: NAMPOWER UUBVLEI POWERSTATION AND POWERLINES

Hi Alynsia

I have a prior arrangement this evening and unfortunately won't be able to attend. Please tender my apologies. I am personally fully in favour of the Uubvley site becoming the preferred location for the Power Station.

Regards
Tony Goosen

Dear Stephanie,

Time flies by so quickly and I get loaded with more and more work.

I was in Uubvley and had discussions there; also I had a chance to speak to Dr D Noli and see more original plans.

My comments are short and sweet:

- - DWA would support the shift from site D to Uubvley.
- - The impact on NAMDEB will be tremendous and some NAMDEB facilities will have to shift elsewhere. This will involve a major planning task for the mine.
- - The infrastructure and sanitary facilities available to NAMPOWER in Oranjemund are not available in Uubvley. They will have to be built. There may be some delay due to NAMDEB clearing the area before NAMPOWER and subcontractors can move in. Again during construction work, the demand on facilities will be much higher than during normal power station operation.

That is all for the time being.
Kind regards,
Roland

-----Original Message-----
From: Stephanie van Zyl [mailto:envirod@africaonline.com.na]
Sent: 01 April 2005 13:20
To: Roeis Roland
Subject: RE: Uubvley Powerstation & lines

Dear Roland,

That is perfectly fine if you send me your comments then.

Regards
stephanie

ENVIRO DYNAMICS (PTY) LTD
P O Box 20837
Windhoek
Tel: 264 61 223336
Fax: 264 61 240309
Cell: 264 81 1287002
E-mail: envirod@africaonline.com.na

-----Original Message-----
From: Roeis Roland [mailto:RoeisR@mawrd.gov.na]
Sent: Friday, April 01, 2005 12:18 PM
To: envirod@africaonline.com.na
Subject: Uubvley Powerstation & lines

Dear Stephanie,
I only realise that the due date for comments is/was 29 March.
I have a tight schedule now and cannot attend to your request for comments.

I will be at Uubvley on 6 April.
If you do not mind I will send you my brief comments from Ms F Olivier's office in Oranjemund (Fiona.olivier@namdeb.na).
I only am back in office on 18 April 2005.

Regards,
Roland

----- Original Message -----
From: Environmetn & Tourism
To: envirod@africaonline.com.na
Sent: Saturday, April 30, 2005 10:55 AM
Subject: Transmission Line Route

Dear Stephanie,

Sorry; I seem to have been away and running the Raleigh International expedition projects ever since the day we parted. Thank you and John again for the opportunity to accompany the inspection.

I confirm that the best route has been chosen. Obviously it would have been nice to run the line along an already-impacted river route, but now that the plant may be situated at Uubvlei, together with the extra distances and costs involved, and the fact that vegetation along the river route would admittedly probably been more severely affected, I am happy that the route we flew - with the changes around the top end of the Schakkalsberge that John was happy to accommodate - is the most sensible and least destructive and located in the best possible way, even taking the landscape into consideration. That is, the direct route towards the Schakkalsberg, then swinging around the northern end of the range through that valley between the very northern-most (very last) kopjie and the dunes/sand, along the valley and then across to the hidden valley I showed you (and then along that hidden valley through the hills west of AMBASE Exploration Camp), passing close to AMBASE and on to the Obib station.

Dieter has confirmed to me as well, that he is happy and it is not the end of the world if it has to pass through a few of the archaeo/palaeo sites he found.

So yes, I think we've come up with the best compromise for such an important project, with the least impact under the circumstances, both on vegetation and landscape. Nobody likes a powerline through pristine wild country, but each case is different, and in this particular case, alternatives would probably be worse.

Thank you and when I have finished the current Raleigh expedition, I shall draft John a request via the channels - as well as a direct copy - for the removal of the old defunct Luderitz - Rosh Pinah line (after 20th May when I am again back in Luderitz).

I don't have John's mail address on me at the moment, but will you send this on to him with my thanks?

Keep well.

Trygve

REPUBLIC OF NAMIBIA

MINISTRY OF WORKS, TRANSPORT AND COMMUNICATION

Tel : (264) - 61-702217
Fax : (264) - 61- 702000
Telex : (50-908) 811/2 WK
E-mail : cateo@mweb.com.na

DIRECTORATE OF CIVIL AVIATION
Private Bag 12005
Aussanenplatz
WINDHOEK
NAMIBIA

Enq: C. SELL Ref: T 25/5/2/1 Date: 16 MAY 2005

The Managing Director
NAMPOWER
P.O. Box 2864
Windhoek
Fax: 232805

For attention: Mr. John Langford

PROPOSED POWERLINE NEAR SKORPION AIRFIELD

1. Reference is made to your e-mail dated 13th may 2005 regarding the erection of a powerline close to the Skorpion airfield.

2. This office is pleased to inform you that it has no objections for the erection of the powerline as recommended in your e-mail.

With kind regards

B.T. Mujetenga
DIRECTOR CIVIL AVIATION

Correspondence must be addressed to the Director: Civil Aviation

APPENDIX 1B

STAKEHOLDERS LIST

STAKEHOLDERS LIST
NAMPOWER UUBVLEI POWER STATION AND POWER LINES EIA'S

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
NAMDEB							
MINEWIDE E-MAIL	Namdeb				Ndb-minewide@namdeb.com	✔	✓
Ms. B. Beukes	Namdeb	E-media Communications Officer	063-239111		Belinda.beukes@namdeb.com (send via internal mail to colleagues)	✔	✓
Mr. Marais Loubser	Namdeb	Geology			Marais.loubser@namdeb.com	✔	✓
Ms. Fiona Olivier	Namdeb	Environmental			Fiona.Olivier@namdeb.com	✔	✓
Bob Burrell	Namdeb	Mineral resources, Geologist	063-235322		Bob.burrell@namdeb.com	✔	✓
Ms. Dawn Jones	Namdeb	Secretary to Mr. Burrell	063-235322		Dawn.jones@namdeb.com	✔	✓
D. Duvenhage	Namdeb		063-235331	063-235155	Dewald.duvenhage@namdeb.com	✔	
R. Duvenhage	Namdeb		063-235744	063-235719	Riana.duvenhage@namdeb.com	✔	
T. De Klerk	Namdeb		063-236736		Tobie.deklerk@namdeb.com	✔	
A.C. Darne	Namdeb		063-237459	063-237521	Andrew.darne@namdeb.com	✔	
T. Conry	NCCI		063-232551	063-232551	elodo@mweb.com.na	✔	
Anca Burger	Namdeb		063-2335807	063-235719	Anca.burger@namdeb.com	✔	
Wicus Burger	Namdeb & ORM Flying Club		063-238650	063-238603	wicus.burger@namdeb.com	✔	
E.S. Iita	MUN		063-235763 0811229435	063-235283	Eliphas.iita@namdeb.com	✔	
D. Popyeinawa	MUN		063-235237 0812422613	063-235283	popyeinawad@namdeb.com	✔	

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
S. Haulofu	MUN		0811284565		haulofus@namdeb.com	✔	
A.N. Gully Muteka	Namdeb		063-233692 08128900388	063-235719	Gully.muteka@namdeb.com	✔	
A. Shanyenge	Namdeb		063-235919	063-235719	Abisai.shanyenge@namdeb.com	✔	
R. Burger	Namdeb		063-235475	063-235719	Riaan.burger@namdeb.com	✔	
C. Burger	Namdeb		0834544690	063-232301	cburger@mweb.com.na info@omd.chcafrica.com	✔	
L. Mauritius	MUN		063-235922 0812776888			✔	
J.K. Kandundu	Namdeb		0812540215	063-238359	joey.kandundu@namdeb.com	✔	
H.A. Cokes Hindjou	MUN		063-235952 0812426754	063-238359	heinrich.hindjou@namdeb.com	✔	
R. Burrell	Namdeb		063-235322	063-235460	bob.burrell@namdeb.com	✔	
GOVERNMENTAL AUTHORITIES:							
F. Amulungu, MHSS P. Silishebo, MME O. Helandjo, MME N. Elias, MME F. Sikabonga, MET I. Mulunga, MME J. Iitenge, MWTC T. Nghitila, MET Dr. S. De Wet, MAWRD Dr. R. Roeis, MAWRD	Inter-Ministerial Review Group				famulungu@mhss.gov.na psilishebo@mme.gov.na ohelandjo@mme.gov.na nelias@mme.gov.na freddy@dea.met.gov.na imulunga@mme.gov.na jiitenge@mwtc.gov.na nghitila@dea.met.gov.na wetsd@mawrd.gov.na roeisr@mawrd.gov.na	✔	✓
Mr. Kevin Roberts	MAWRD – Dept Water Affairs		061-208 7111	061-2087160	robertsk@mawrd.gov.na	✔	✓
Dr G Maggs-Koelling	MAWRD-National Botanical Research Institute	Director	061-2022167	061-279602	gmk@mweb.com.na	✔	✓
Mr Burger Oelofsen	MFMR – Resource Management South Area	Director			boelofsen@mfmr.gov.na	✔	✓
Mr. Booysen	Ministry of Works, Dep. Of Maintenance	Windhoek	061 2088207	061-2088634	Private Bag 12005, Ausspannplatz, Windhoek	✓	

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
Mr. Sem Shikongo	MET, Directorate of Environmental Affairs	Environmental Affairs		240339	sts@dea.met.gov.na	✔	✓
Mr H Kolberg	MET, Department of Tourism	Conservation Scientist			hertak@mweb.com.na	✔	✓
Library	MET – Department of Environmental Affairs		061-249015	061-240339	smitw@dea.met.gov.na	✔	✓
Mr. Trygve Cooper	Ministry of Environment & Tourism (MET)	Nature Conservation – Director of Parks & Wildlife	063 202811	063 204188	Box 426, Lüderitz metlud@iway.na	✔	✓
Mr Patrick Lane	MET	Chief Warden Southern Parks	063-222510	063-225621	Keetmanshoop metlud@iway.na	✔	✓
Mr. Nico Kisting	MET				niko@dea.met.gov.na	✔	✓
Mr. Theo Nghithila	MET - DEA	Acting Director	249015	240339	nghitila@dea.met.gov.na	✔	✓
Ms Connie Claasen	MET - DEA	EEU	061-249015	061-240339	connie@dea.met.gov.na	✔	✓
Mr. Ben Beittel	MET Directorate Parks, Wildlife Management	Director		061-263195	bbeitell@mweb.com.na	✔	✓
Mr. Mike Griffin	MET				ssaurus@iafrica.com.na	✔	✓
Dr G Schreider	MME, Geological Survey	Director	2085205	249144/ 238643		✔	
Dr A Macuvele	MME, Mining Commissioner	Mining Commissioner		238643		✔	
Mr. Simasiku	MME		061-226571	061-220386	Private Bag 13297 Windhoek	✔	
Mr. Louis Esterhuizen	Ministry of Regional and Local Government and Housing	297 5179			lesterhuizen@mrlgh.gov.na	✔	✓
Mr. P. Swart	MRLGH	297 5111			pswart@mrlgh.gov.na	✔	✓
Mr. J. Sell	MWTC, Directorate Civil Avaiation		2082217 0811241423	234100	catco@mweb.com.na	✔	✓
Mr. P. Heyns	MAWRD- Department of Water Affairs	Director: Investigations and Research	061-2969111	061-232861	Private Bag 13193 Windhoek	✔	
Mr. Eric Tordiffe	MAWRD – Department of Water Affairs, Geohydrology		061-2087145	061-2087149	TordiffE@mawrd.gov.na	✔	✓

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
Mr T Parkhouse	Namibian Chamber of Commerce	Managing Director	061-222000	061-233690		✔	
NAMPORT						✔	
Cpt. Gusev	NamPort	Port Captain	063-200203	063-200218		✔	
Mr. W Ernt	NamPort	Port Engineer	063-200217	063-200218		✔	
Leon	NamPort				leon@namport.com.na	✔	✓
REGIONAL AND LOCAL AUTHORITIES						✔	
Hon. Mr Fluksman Samuehl	Karas Regional Council	Councillor of Lüderitz	063-2028000	063-226121	fsamuehl@iway.na	✔	✔
Hon Mr Goliath	Karas Regional Council	Regional Governor		063-223538		✔	✔
Mr. J. Stephanus	Karas Regional Council	Regional Officer		063-223538		✔	✔
Ms. Leonora Joodt	Karas Regional Council		063-223723	063-223538	leonorabj@webmail.co.za		✓✔
Epson Jossop	Keetmanshoop Municipality		063-221224	063-223818	pro@keetmanshoopmun.org.na	✔	✓
Mr. George Kozonguizi	City of Windhoek, Environmental Division		061-290 2371		Gkk@windhoekcc.org.na	✔	✓
FISHING INDUSTRY:							✔
M Clay	Seaflower Group	Managing Director			janp@seaflower.com.na (distributed to all fishing co's)	✔	✓
NGO's:						✔	
Dr Mary Seely	(DRFN) Desert Research Foundation	Director - Desert Ecologist	061-229855	061-230172	drfn@drfn.org.za mseely@drfn.org.na	✔	✓
Mr. Aboobakar	NDC	Managing Director	2062111	223854		✔	
Mr. J. C Rogers	Chamber of Mines		061-237925	061-222638	P.O. Box 2895 Windhoek	✔	
Mr. Nicolaas Du Plessis	Namwater	Environmental Manager			PlessisN@namwater.com.na	✔	✓

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
	Hospitality Association of Namibia (HAN)		061-222904	061-222904	han@mweb.com.na	✔	✓
	Namibian Academy for Tourism and Hospitality (NATH)		061-259288	061-259221	nath@naminet.com	✔	✓
	Tourism Related Namibian Business Association (TRENABA)		061-236191	061-245756	africuri@mweb.com.na	✔	✓
Mr G Fuller	TASA	Chairperson	061- 238423	061-238424	tasa@iafria.com.na	✔	✓
Mr J Midgley	NAMCO	Environmental Manager			namone@iafrica.com.na (mailed back, wrong address)	✔	✓
Mr J Maizenge	NAMCOR	Managing Director			namcor@namcor.com.na	✔	✓
Mr Roger Swart McG Miler, Dr Roy	NAMCOR		061-221699	061-221785	Private Bag 13196 Windhoek	✔	
Mrs E Burkhard	TAN, Tour Guide Association	Chairperson			henniefo@mweb.com.na	✔	✓
	Namibia tourism Information				info@namibiatourism	✔	✓
Ms Bertchen Kohrs	Earthlife Namibia	Chairperson	061-2022041	061-221962	P.O. Box 24892 Windhoek, earthl@iway.na	✔	✓
Mr. G Fuller	Wildlife Society	Chairperson	061-241786	061-242318	P.O. Box 3508 Windhoek	✔	
Mr.Dave Joubert	Wildlife Society		061-2072462	061-2072143	djoubert@polytechnic.edu.na	✔	✓
Ms. Birgit Eimbeck	Wildlife Society		061-275700	061-249444 0811276923	eimbeckb@namharvest.com.na	✔	✓
Dr C Brown	Namibia Nature Foundation				cb@nnf.org.na mm@nnf.org.na	✔	✓
	NACOBTA				nacobta@iafrica.com.na	✔	✓
Mr. Nils Wormsbacher	R3E				energy@r3e.org	✔	✓
Mr. Robert Schulz	R3E				energy@r3e.org	✔	✓
Ms. Liz Komen	NARREC				liz@narrec.schoolnet.na	✔	✓
MEDIA:							
Mr. Smith	Windhoek Observer	Editor	221737	221738	whkob@africaonline.com.na	✔	✓

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
Mr D Heinrich	Allgemeine Zeitung	Editor	225822	245200	azinfo@az.com.na	✔	✓
Mr. D. Vries	New Era	Editor	273300	220584	dawud@newera.com.na	✔	
Mr C Jacobie	Die Republikein	Editor			republkn@republikein.com.na info@republikein.com.na	✔	✓
Mr. Gary Munjama	NBC	Director General	2913111	216209		✓	✔
Ms G Lister	The Namibian	Editor			newseditor@namibian.com.na	✔	✓
NAMPA	Namibian Press Agency			221713	news@nampa.org	✔	✓
ROSH PINAH						✔	
Mr. Dawid Mouton	Scorpion Zinc (Namzinc)	Environmental Coordinator	063-271 2142	063-271 2526	Dmouton@skorpionzinc.com.na	✔	✓
Mr. Jegg Christiaan	Rosh Pinah Zinc (Roshcor)	PRO	063-274200		Jegg.christiaan@kumbaresources.com	✔	✓
S. Du Toit	Shell South Africa	Regional Manager	063-233425	063-234171		✓	
ALEXANDER BAY							
Mr. Clifford Oppel	Alexkor	Environmentalist	+2727 8311330		cliffordo@alexkor.co.za	✔	✓
Ms. Alana Mostert	Alexkor		+27278311330		alanam@alexkor.co.za	✔	✓
Mr. Manfred Louw	Alexkor	Environmental Manager	+27083998608		manfredl@alexkor.co.za	✔	✓
ORANJEMUND BUSINESS COMMUNITY:							
P.S. Chikumba	Air Namibia		063-232449/ 232638	063-232225		✓	✔
D. Van Rensburg	B&E Namibia (Pty) Ltd		063-233229/ 233681	063-233681		✓	✔
J.J. Van Rooi	Bell Equipment		063-237502	063-234133		✓	✔
Ministry of Mines & Energy				063-233779		✓	✔

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
H. Iidhenga	MOF, Customs & Excise		063-233552	063-233552		✓	✔
Ace Komeya	Mobilehome (MTC)		063-234166	063-234167		✓	✔
P. Johr	Namibia Post		063-232315	063-232315		✓	✔
E. Iikuyu	Namibia Police		063-232400	063-23344		✓	✔
G. Lumley	Nashua		063-232255	063-232285		✓	✔
M. Du Plessis	Bank Windhoek		063-233544	063-233119	oranjemunbranch@bankwindhoek.com.na	✔	✓
	First National Bank		063-3525211	063-232215	fnboranjemund@nfbnamibia.com.na	✔	✓
	Karibib Mining & Construction		063-232527	063-233011	info@kaibib-mining.com	✔	✓
	M & Z Commercial Vehicles		063-232129		mznamdeb@metjeziegler.com	✔	✓
	Namdeb Hospital		063-238000	063-238082		✓	✔
	Namhealth Administrators		063-232295	063-232191		✓	✔
	Namib Mills		063-232976	063-232985	info@namibmills.com.na	✔	✓
H. Webster	Pupkewitz Megabuild		063-234300	063-234305	oramega@pupkewitz.com	✔	✓
A. Van Staden	Rennies Travel Services		063-233463	063-234285	Avrilvs.rennies@galileosa.co.za	✔	✓
A.J. Christiaan	Telecom Namibia		063-232666	063-232037		✓	✔
	TransNamib		063-232097	063-232225		✓	✔
	Woker Travel Services		063-233463	063-233294		✓	✔
Mr. G. Stubenrauch	Stubenrauch Planning Consultants		061-251189		gunther@spc.iway.na	✔	✓
OTHER:							
	PRU, Oranjemund		063-232596	063-233444		✓	✔

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
Mr. Ibo Zimmermann	Polytechnic of Namibia				ibozim@polytechnic.edu.na	✔	✓
Mr. Rudi Kruger	Eskom				KrugerR@eskom.co.za	✔	✓
Mr I Kalenga	SWAPO	Regional Secretary			0811248842 oms@iway.na	✔	✓
Mr. Eliphas Iita	MUN		063-232145 235763	063-232050		✔	✔
Mr. Silas Antonius	MUN		063-232145 203565	063-232050		✔	✔
Mr. S. Simasiku	Electricity Control Board	Chief Executive Officer	061-374300	220386	ssimasiku@ecb.org.na	✔	✓
Mr. R. Kapenda	National Union of Namibian Workers (NUNW)	President	061-215037		nunw@mweb.com.na	✔	✓
Martha	UNDP – Environment Unit				mwangindgi@undp.org.na	✔	✓
Buddy Kunondjo Mukona	NAMSCA		0812881449	212767	www.namsca.com.na	✔	✓
Christelle Tromp	Environmentalist		230679/08124 43138	227406	nrc@mweb.com.na	✔	✓
Kobus Coetzer	Technical		00271161720 00/278238709 72	2368214	Kobus.coetzer@za.abb.com	✔	✓
Takalani Radali	Environmental Management Advisor		0832567474		Takalani.radali@eskom.co.za	✔	✓
Sion Shifa	Environmentalist		0812781707		ndemuuda@webmail.co.za	✔	✓
Johannes Haindongo	Environmentalist		219388/08128 51192		hinyekwa@webmail.coza	✔	✓
Nathan Kayambu	Environmentalist		264342/08128 67981		nathann@webmail.co.za	✔	✓
Lance Williamson	Business – Skorpion Zinc		063-2712383/2783 4117882	063-2712526	lwilliamson@skorpionzinc.com.na	✔	✓
Angula Nashandi	Power Engineering student majoring projects		259777/08127 08399		S200100343.student@polytechnic.edu.na	✔	✓
Derek Phillips	Business		278700/08112 77716	278701	Derek.Phillips@Siemens.com	✔	✓

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
Simon Sebueng	Education		2072517/0812 807633	2072142	ssebueng@polytechnic.edu.na	✔	✓
Hileni Ollyn Nghinaunye	Private		0812819805		PO Box 4008, WHK	✔	✓
Jane Gold	Resident		252604		janegold@iafrica.com.na	✔	✓
Alexandra Speiser	Private	Consultant			amspeiser@yahoo.com	✔	✓
Mr. Andrew Clegg	Private				asclegg@mweb.com.na	✔	✓
Ms. Antje Burke	Enviro Science	Consultant			Antje.burke@enviro-science.info	✔	✓
Ms. Barbara Curtis	Namibia Tree Atlas, NBRI				treeatlas@mwe.com.na	✔	✓
Mr. B. Strohbach	Private	Botanist			bens@mweb.com.na	✔	✓
Ms.Coleen Mannheimer	Private	Consultant			manfam@africaonline.com.na	✔	✓
Mr. Colin Christian	Eco-Plan				eco-plan@iafrica.com.na	✔	✓
Mr. Ed Barbour	Private	Geohydrologist			ebarbour@mweb.com.na	✔	✓
Mr. J Goreseb	Greeninfo				greeninfo@groups.namweb.com.na jgo@windhoekcc.org.na	✔	✓
Mr. John Irish	Private	Enthomologist			jirish@mweb.com.na	✔	✓
Dr. P. Barnard	Private				barnard@nbict.nbi.ac.za	✔	✓
The Secretary	Scientific Society		061-225372	061-226846	nwg@iafrica.com.na	✔	✓
Tharina Bird	National Museum	Curator: Arachnids			tharina@natmus.cul.na	✔	✓
Volker Fisher-Buder	Africa Consulting Services		061-237427	061-225704	volkerfb@ssi.com.na	✔	✓
Mr. Dan Singh	Port Nolloth Municipality		+2727 8511111	+2727 8511101	port@lantic.net	✔	✓

NAME	ORGANISATION	DEPT	TEL:	FAX:	ADDRESS &/or E-MAIL	SENT BY FAX:	SENT BY E-MAIL:
SOUTH AFRICAN GOVERNMENTAL AUTHORITIES							
Mr. D. Potgieter	Department of Water Affairs (Geodydrology) (Water Quality Management		+2753 807 4800		potgied@dwaf.gov.za	✔	✓
Mr. Mark Anderson	Northern Cape Nature Conservation Service				Private Bag X6102 Kimberly, 8300 manderson@grand.ncape.gov.za	✔	✓
Mr. P. Morant/ H. Fortuin	CSIR				pmorant@csir.co.za hfortuin@csirc.co.za	✔	✓
Dr. Peter Tarr	SAIEA				Peter.tarr@saiea.com	✔	✓
Mr. Gerr Kegge	Energy Africa				kegge@iafrica.com.na	✔	✓

APPENDIX 1C

BACKGROUND INFORMATION DOCUMENT

Invitation to comment on additional EIA studies for the Kudu Gas to Power Project

NamPower hereby invites all Interested and Affected persons or institutions to give their opinion on the key issues that need to be addressed in the completion of the studies aimed at assessing the environmental impacts of the Kudu Gas to Power Project.

Background

In view of the need to ensure that the project results in the lowest possible social, ecological and archaeological impacts, NamPower have considered a number of options for the siting of the power plant which, in turn, somewhat dictates the alignment of the power lines and the gas supply pipe line. The 1998 Preliminary EIA and the 2004 full EIA found site D to be acceptable technically and environmentally. However, NamPower has decided to also fully consider Uubvley as a possible alternative site, mainly because the routing of a gas pipeline from the gas platform to the proposed Site D will likely cause opportunity costs (because of possible diamond lock-up offshore) and inconvenience ongoing mining activities in the immediate area.

A preliminary investigation by NamPower, Namdeb and Energy Africa has identified Uubvley as probably the most suitable alternative site based on the following criteria:

- Cost implications
- Already disturbed/mined-out area (i.e. minimal impacts on biodiversity and landscapes)
- Minimal interference with Namdeb mining operations
- Availability of cooling water for the Power Station
- Good founding conditions for the Power Station and landing site for the gas pipeline and seawater intake pipeline
- Proximity to infrastructure and services
- Minimal impact on mining reserves offshore
- Suitability for the alignment of transmission lines (interconnectivity)

This decision requires additional work to be completed for all three components of the project.

Additional studies

The work done so far by CSIR and Enviro Dynamics has focused mainly on Site D (south-west of Oranjemund) and on the power line routes from Site D into the Namibian and South African power grids. Much of this work is valid for the investigation of Uubvley Site, but some new studies will be needed.

Based on discussions with the consultants and various experts, the following issues have already been identified as requiring additional or new work:

- Description of the biophysical characteristics of Uubvley Site
- Options for water abstraction for cooling given the differences between Uubvley and Site D (i.e. from beach wells, ponds or directly from the ocean)
- Options for purge water discharge given the differences between Uubvley and Site D (i.e. into

ponds, onto the beach/intertidal zone, or beyond the breakers)
- The suitability of existing facilities to accommodate the workforce during construction, and possibly operation.
- Options for supply of services for workers - water, electricity, recreation facilities, health services, catering, etc.
- Options for waste management – industrial waste during construction, household waste, sewerage, hazardous waste
- Maintenance of the road between Uubvley and Oranjemund
- Security issues and access to site
- Interactions with Namdeb
- Climate – implications for corrosion, dust control, etc.
- New alignments for the power lines and their social and environmental acceptability

Initial opinions are that establishing the plant at Uubvley Site will solve a number of the perceived drawbacks of Site D. These are:
- Visual distraction for Oranjemund residents
- Noise impacts for Oranjemund residents
- Pollution (specifically the impacts of pollution on people)
- The danger to people of non-standard operating situations (the unlikely event of an accident)
- Power lines in proximity to Oranjemund and bird flight paths
- Negative interactions between workers and the Oranjemund residents

What you can do

NamPower respects your opinion as an Interested and possibly Affected Party, and is eager to hear from you regarding this project.

Many of you have already attended meetings during the previous round of consultations, and your opinions have been recorded in the recently completed EIAs for the Power Station and the power lines. However, you might now have additional thoughts about the project because of the possible shift to Uubvley Site.

In addition to any general comments you might have, we are particularly keen to hear your opinion regarding the additional work that the consultants need to do regarding the Uubvley option.

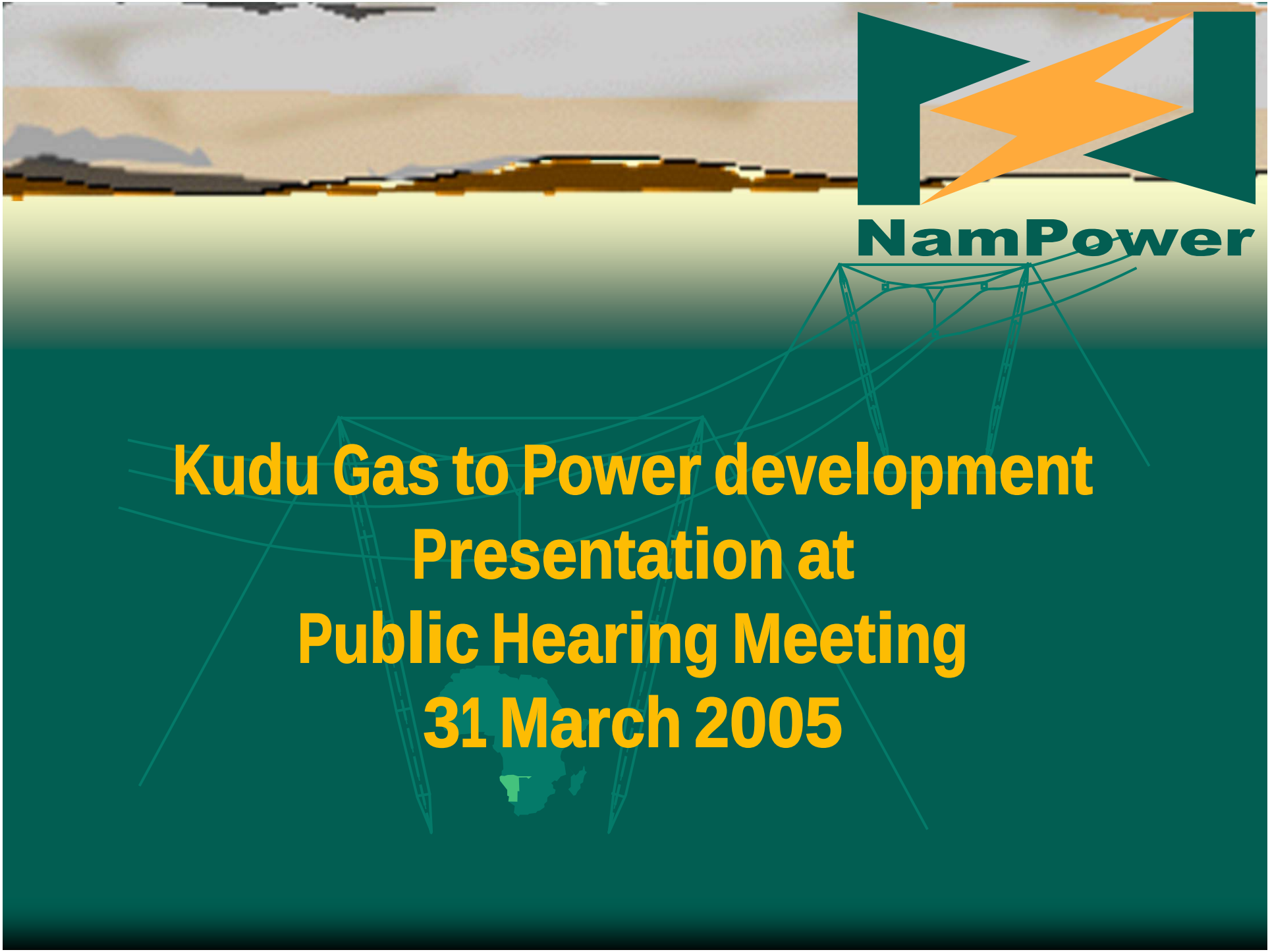
Although we face an extremely tight schedule, a public hearing meeting will be held at Oranjemund on the 31 March 2005 at the School Auditorium at 17:30. For this reason, you are requested to provide your input in writing or telephonically before the meeting takes place.

It would thus be appreciated if you could send your suggestions or comments to Mrs. Stephanie van Zyl, Enviro Dynamics: E-mail envirod@africaonline.com.na – as soon as possible, but preferably before 29 March 2005. She can also be reached at 061- 223336

Thanking you in anticipation!

APPENDIX 1D

PRESENTATIONS



Kudu Gas to Power development
Presentation at
Public Hearing Meeting
31 March 2005

Programme

- 17:30 Introduction by NamPower (5 min)
- Power Station
  - 17:35 Technical Presentation– NamPower (20 min)
  - 17:55 Environmental Presentation – Enviro Dynamics (20 min)
  - 18:15 Feedback from public (20 min)
- 18:35 Tea Break (10 min)
- Transmission Lines
  - 18:45 Technical Presentation NamPower (10 min)
  - 18:55 Environmental presentation (20 min)
  - 19:15 Feedback from public (20 min)
- 19:35 Close

NamPower

Introduction

- ROD for EIA for site D 2,5 km SW of Oranjemund issued by MET in December 2004
- Awaiting a ROD from MET on the transmission lines from site D
- Potential Lockup of diamond reserves in Atlantic 1 concession area by off-shore pipe line route to site D
- NamPower, Energy Africa and Namdeb decide to investigate alternative sites
- Uubvley was chosen as a second possible site after evaluating sites at Cliff Site, Uubvley and #2 Plant
- In order to prove Uubvley technical feasible, NamPower needs to conduct various studies i.e.. Cooling Water, Sediment Transport and EIA's for the Power Station and Transmission lines
- Could result in a 6 to 12 month delay of the project

NamPower

Introduction

- NamPower's recognizes responsibility to consult with stakeholders and to foster sustainable development of Oranjemund town
- We are here to inform the public about:
  - The power station site at Uubvley
    - Technical aspects
    - Environmental considerations
  - Transmission line integration from Uubvley
    - Route alternatives
    - Environmental considerations
- Need your inputs to ensure that the EIA considers all issues

NamPower

Power Station
Technical Presentation

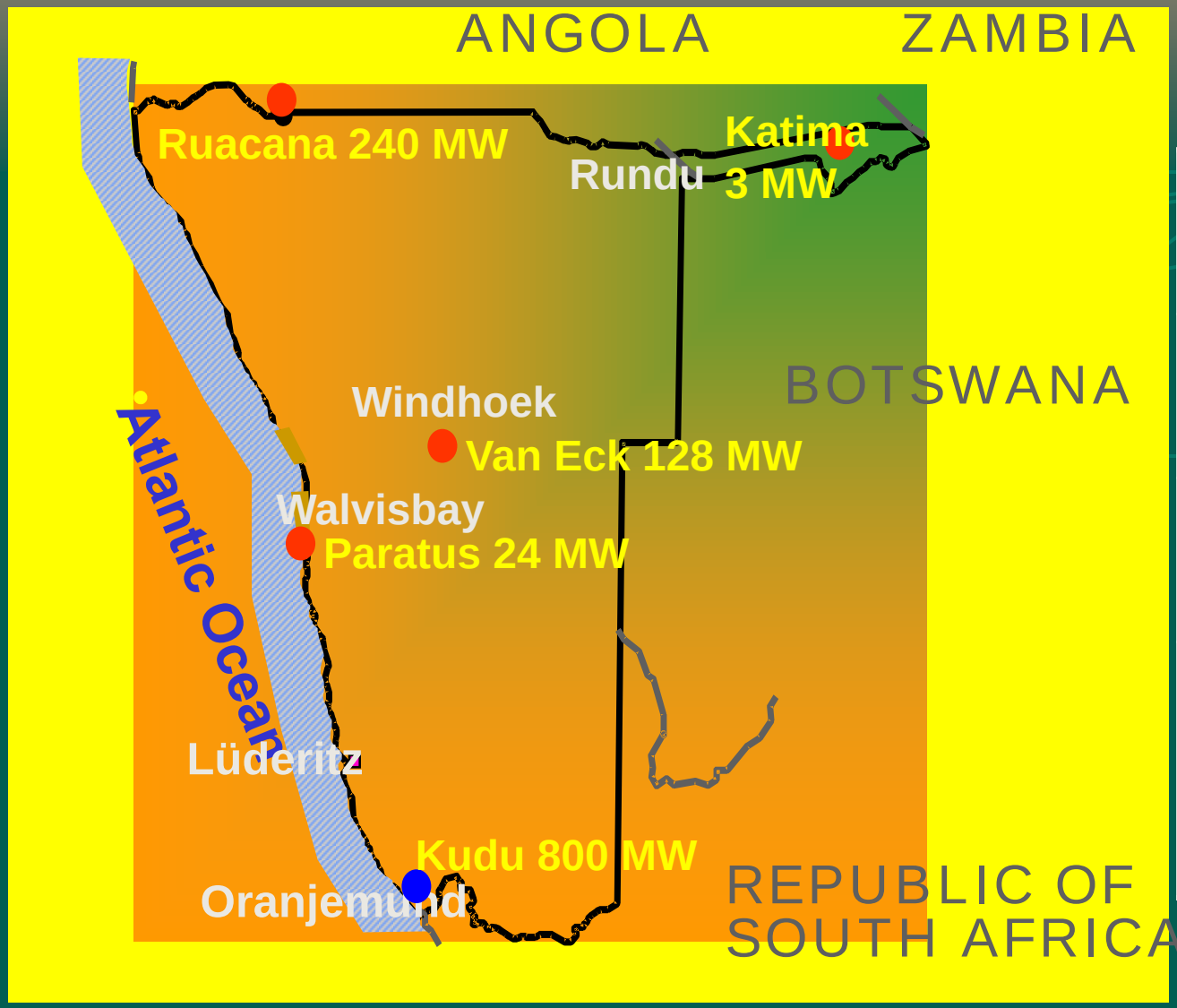
NamPower

Why do we need to build the Kudu CCGT Power Station?

- Shortfall in electricity supply in Namibia and region
  - Namibia Max Demand 2004 – 507 MW
  - Namibia Installed Capacity – 392 MW
  - Namibia Practical Capacity – 120 MW
- NamPower needs to re-negotiate bilateral power agreement for import of power from South Africa
- Expected price hikes when South African demand outstrip supply - 2007
- Self-sufficiency for Namibia
- Developing our natural resources

NamPower

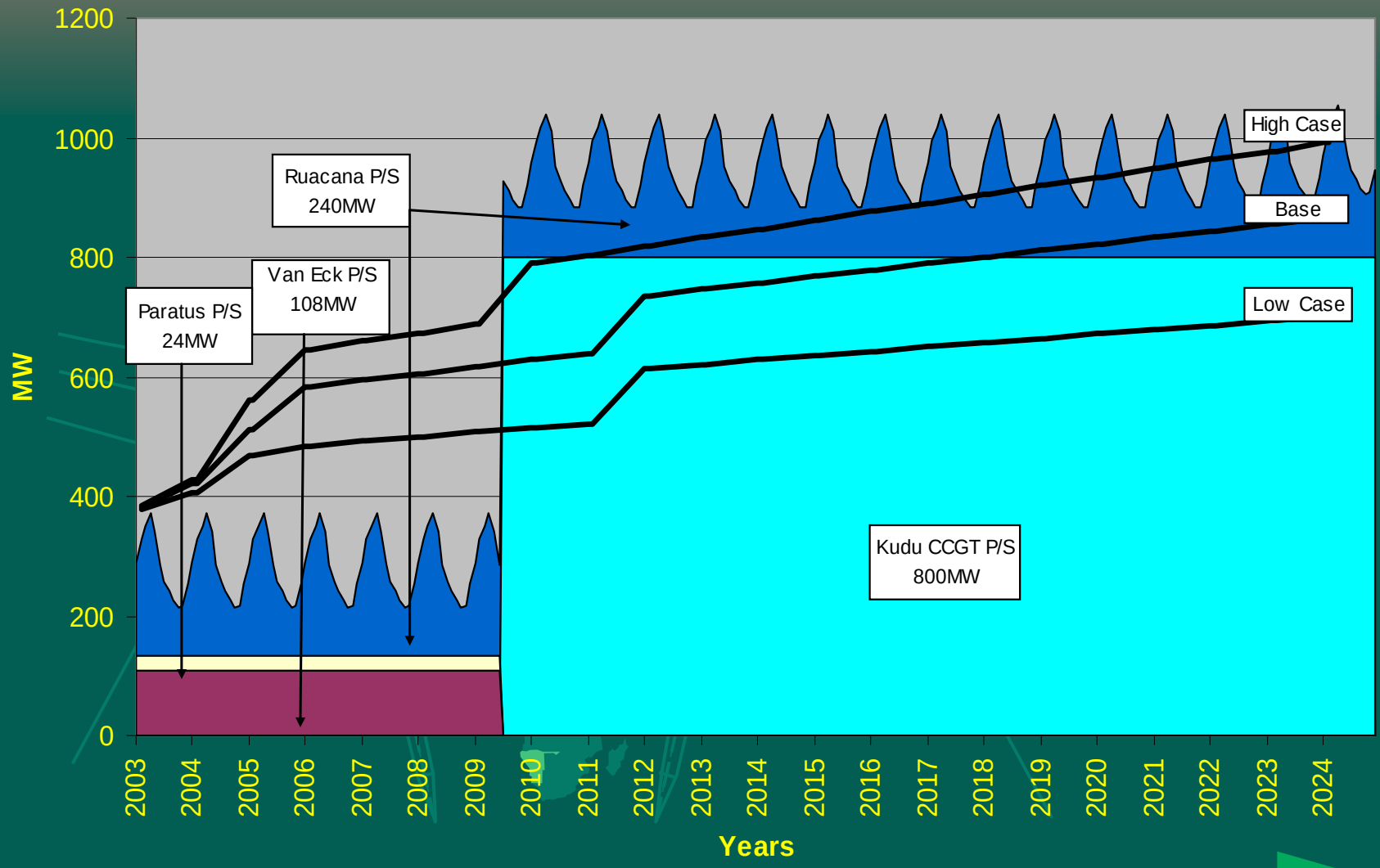
Power Stations in Namibia



Ruacana Hydro, Run-of-the-river
Van Eck Coal fired, Standby
Paratus Diesel & HFO Standby
Katima Diesel, Standby, not connected to rest of Grid

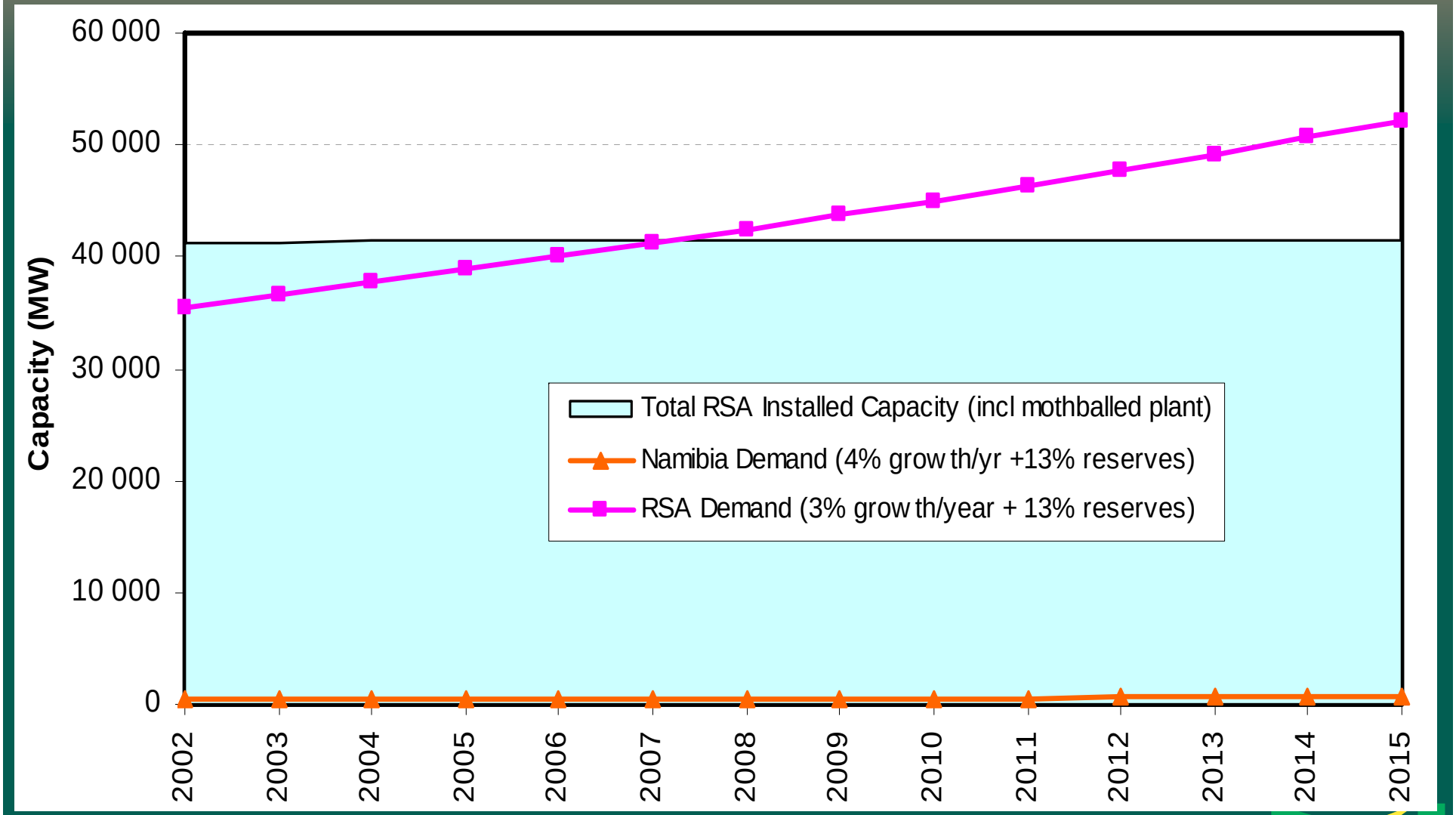
NamPower

Namibian Demand Supply Graph



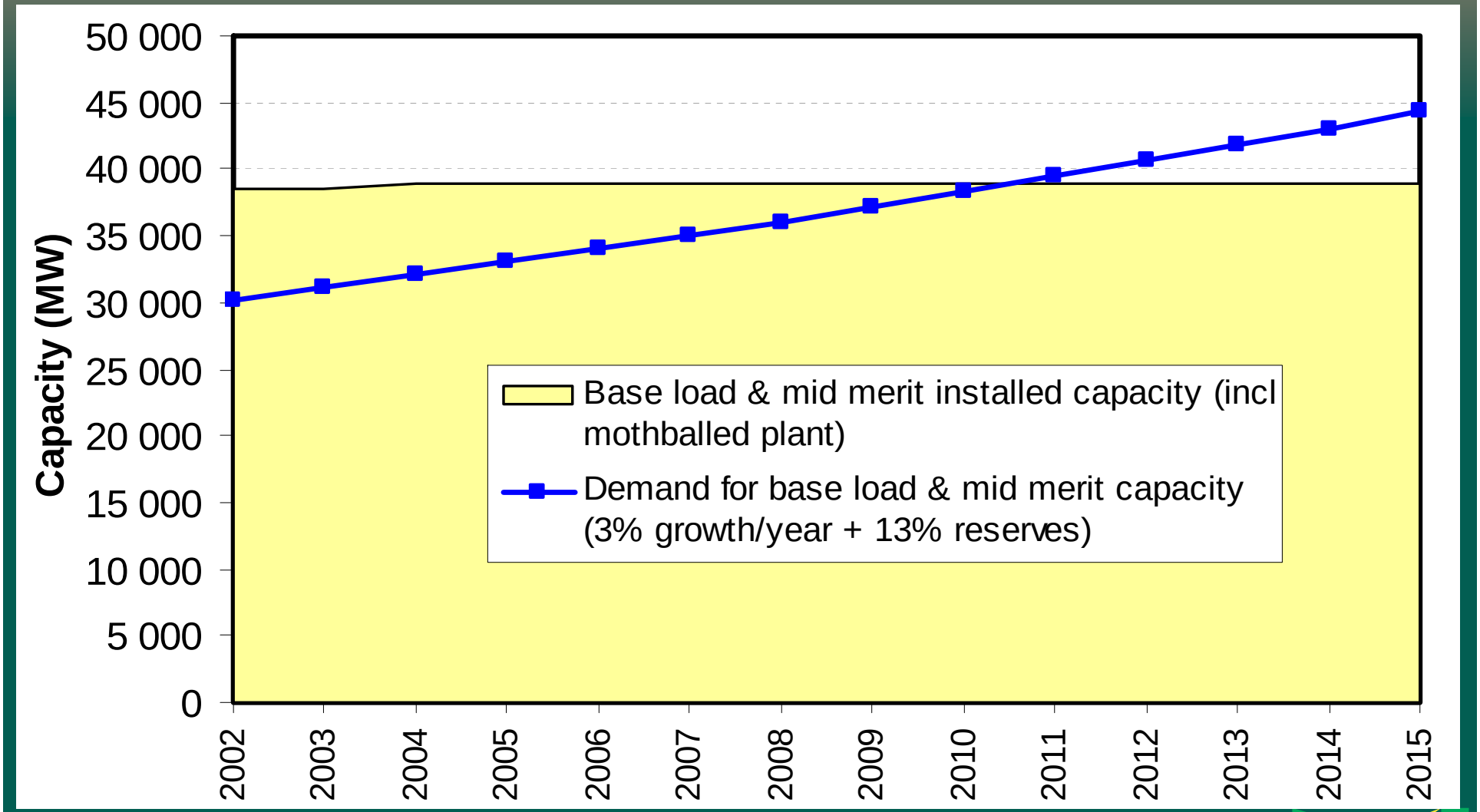
NamPower

Total Demand & Supply Projections for RSA



NamPower

Base load & mid- merit Demand & Supply Projections for SA



NamPower

Potential Namibian Power Projects

Power Source	Operational Mode	Capacity MW	Construction Time Years	Earliest Comm. date
Lower Kunene Hydros	Base	1600	n/a	n/a
Epupa/ Baynes Hydro	Base	360	9	2014
Baynes Hydro	Mid-merit	500-600	10	2015
Kudu Gas CCGT Phase 1	Base	800	5	2010
Kudu Gas CCGT Phase 2	Base	800	5	2015
Orange River Mini Hydros	Base	72	4	2010
Popa Falls	Base	21	6	2011

NamPower

Kudu Project Scheme

Gas Supply Agreement

Kudu Upstream JV

Energy Africa

Namcor

+ Partners

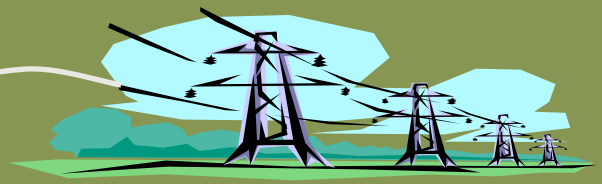
Kudu Power Station Company

NamPower + Partners

- **Phase 1 first 800MW**
- **2 - 3 years production**
- **Phase 2 second 800MW**

Power Purchase Agreement

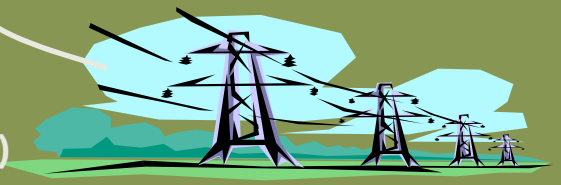
NamPower



Domestic sales in Namibia

Export sales

Power Purchase Agreement (s)



Vision for Kudu

- Namibian gas to power phased development with exported power into Southern African power pool
  - 1.45 Tscf audited (P90) gas in place – reserve about 22 years for 800MW power plant
  - 2.72 Tscf audited best estimate (P50) gas in place – reserve >25 years for 1600MW power plant
- Large remaining upside gas potential > 7 Tscf
  - Farm-in opportunity

NamPower

Kudu Power Station: Impact on Region

- **Timing, Availability of New Generation in 2009**
- **Strengthening of Regional Grid**
- **Reduction in Transmission losses**
- **Diversification of energy mix portfolio, especially to encourage the introduction of natural gas and to increase the role of renewable energy sources**
- **Socio Economic injection**
- **Development of Namibia's gas resources**

NamPower

Site Selection

- Criteria
  - Location with regard to adequacy of cooling water supply
  - Topography and available plot area
  - Ground conditions, particularly extent of bedrock
  - General environmental impact and acceptability
  - Access for construction
  - Fuel supplies and access to gas supply pipe line
- Transmission line routing

NamPower

Kudu Power Station Configuration

- 1st Phase (based on P90 results)
  - 800 MW (nominal) Combined Cycle Gas and Steam Turbines (CCGT),
- 2ND Phase (after upside is proven)
  - Additional 800 MW (nominal) Combined Cycle Gas and Steam Turbines
- Mechanical draft evaporative cooling towers with saline water make-up
- Generator Transformers to bus bar (22kV:400kV)

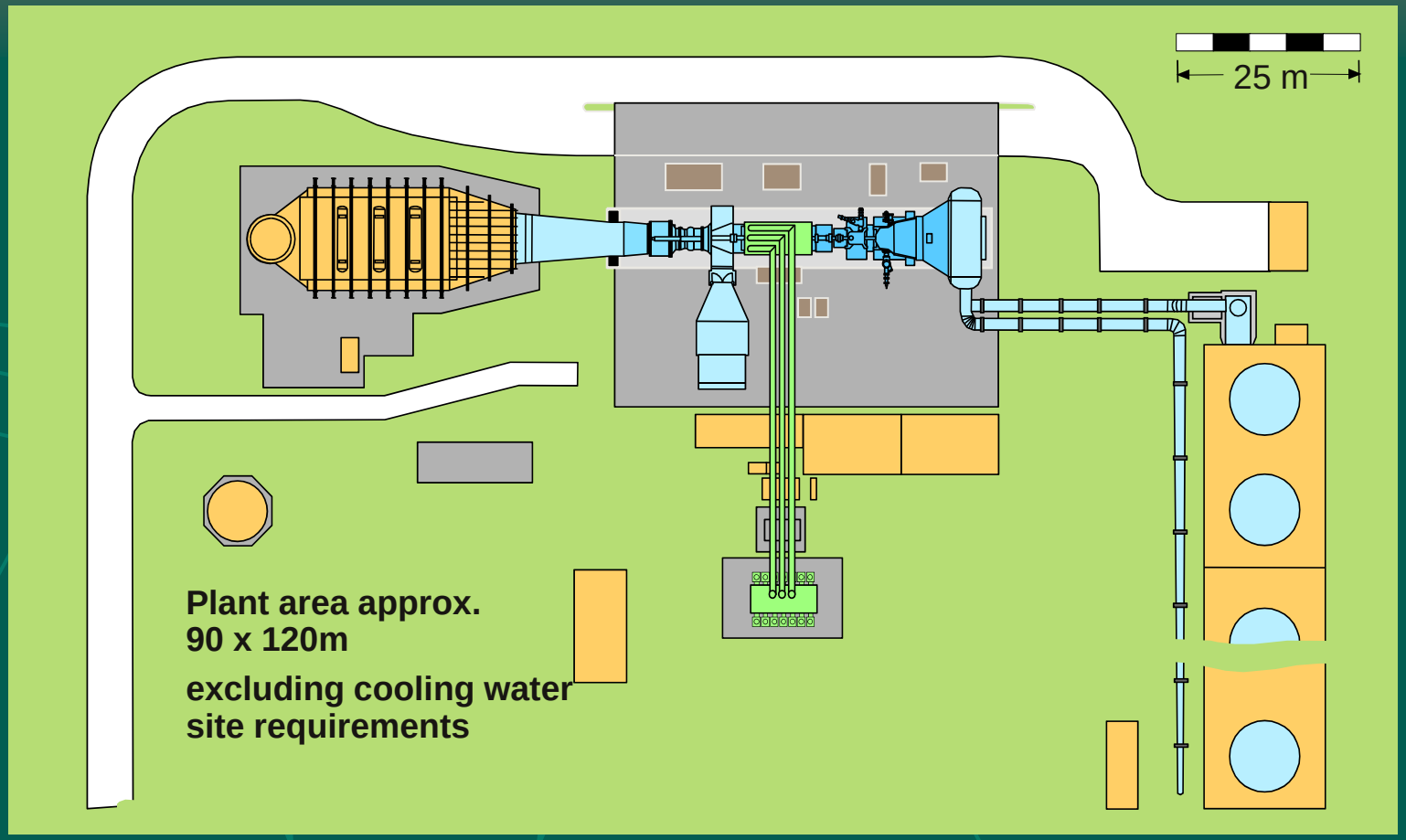
NamPower

Power station layout

- 800 MW – 325 m by 570 m
- 1600 MW – 650 m by 570 m
- Construction camp approx. 10 – 15 ha

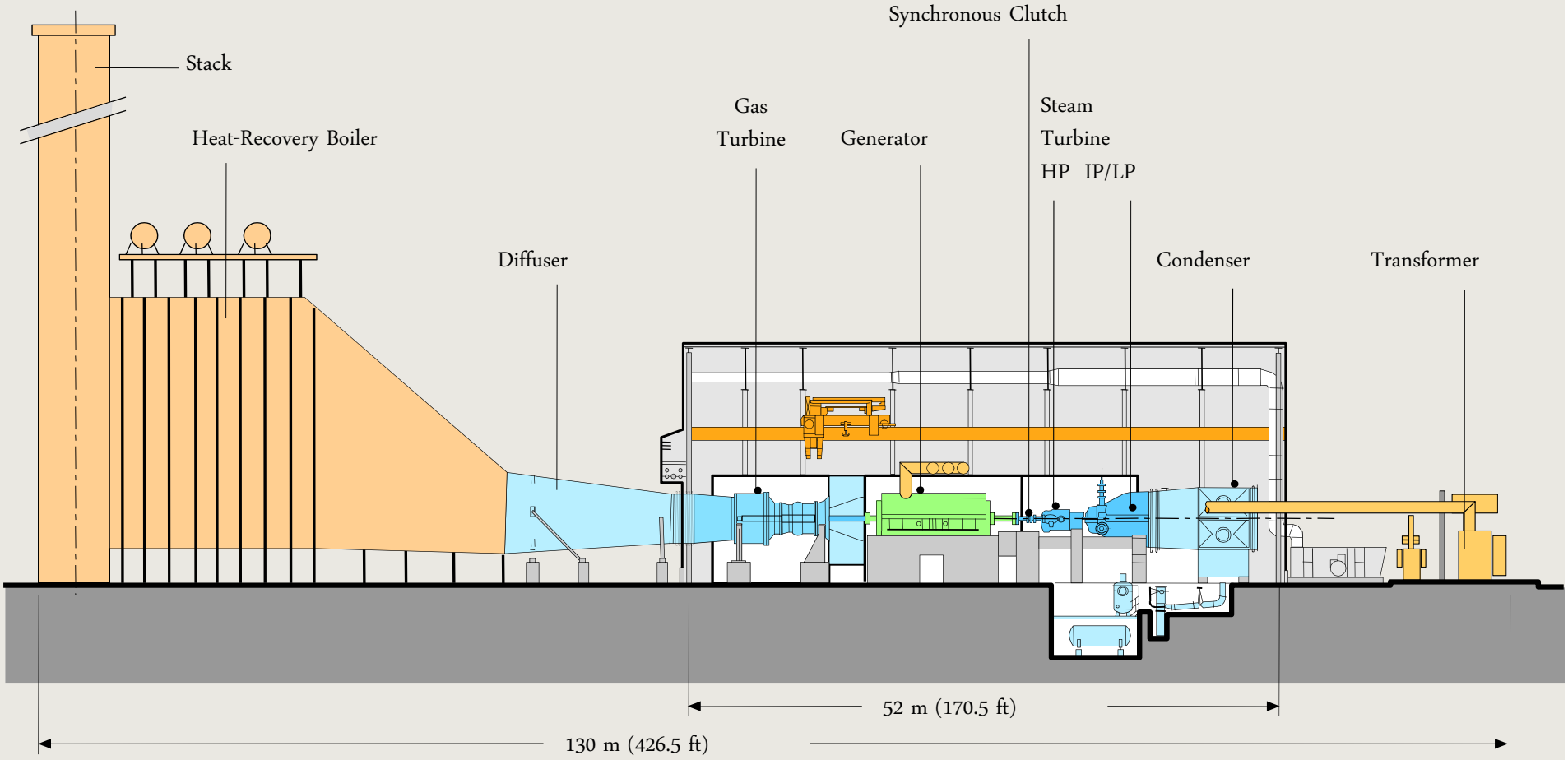
NamPower

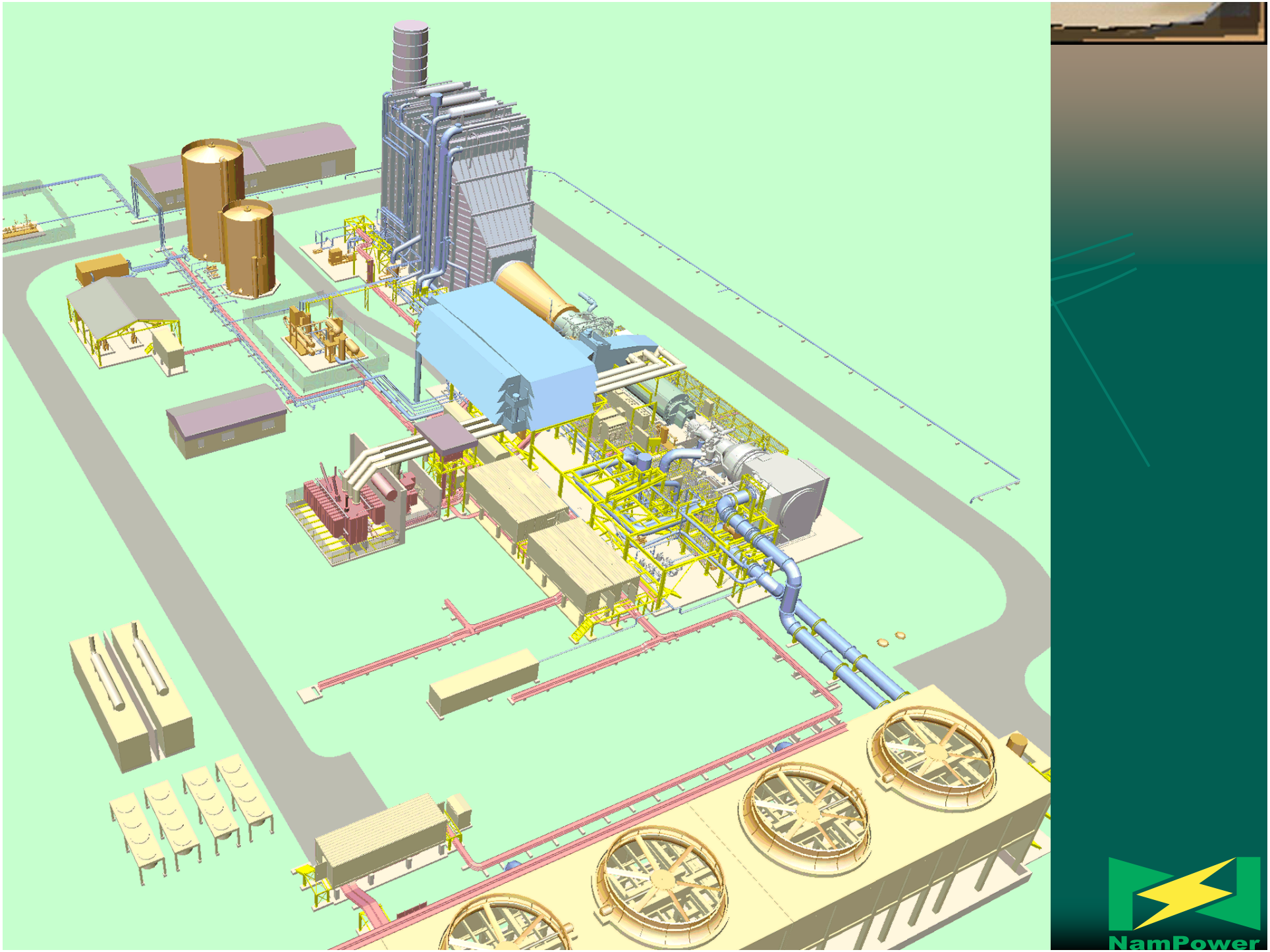
Combined Cycle Power Plant
400 MW Single Shaft- Layout Plan



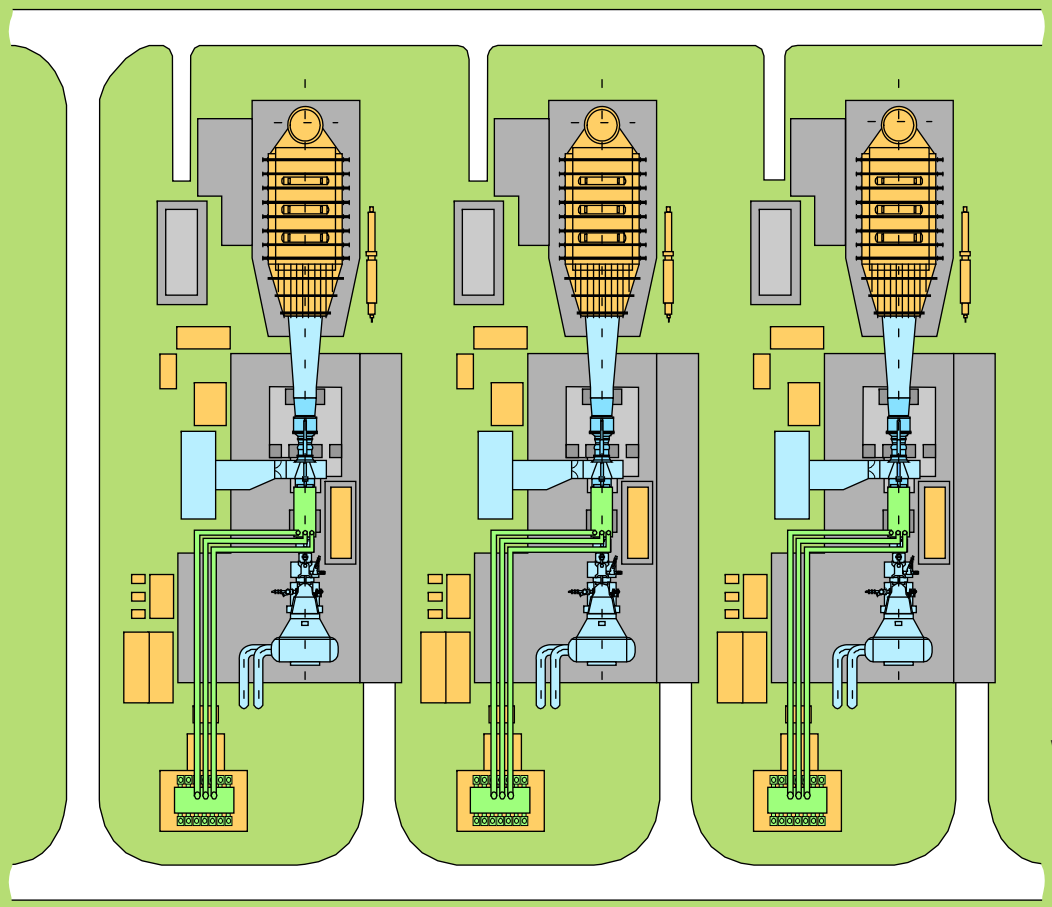
NamPower

Elevation 392 MW, 50 Hz Single-Shaft CC Block Arrangement with Horizontal Heat-Recovery Boiler




NamPower

Combined Cycle Power Plant 3x 400 MW
Single Shaft Units- Layout Plan

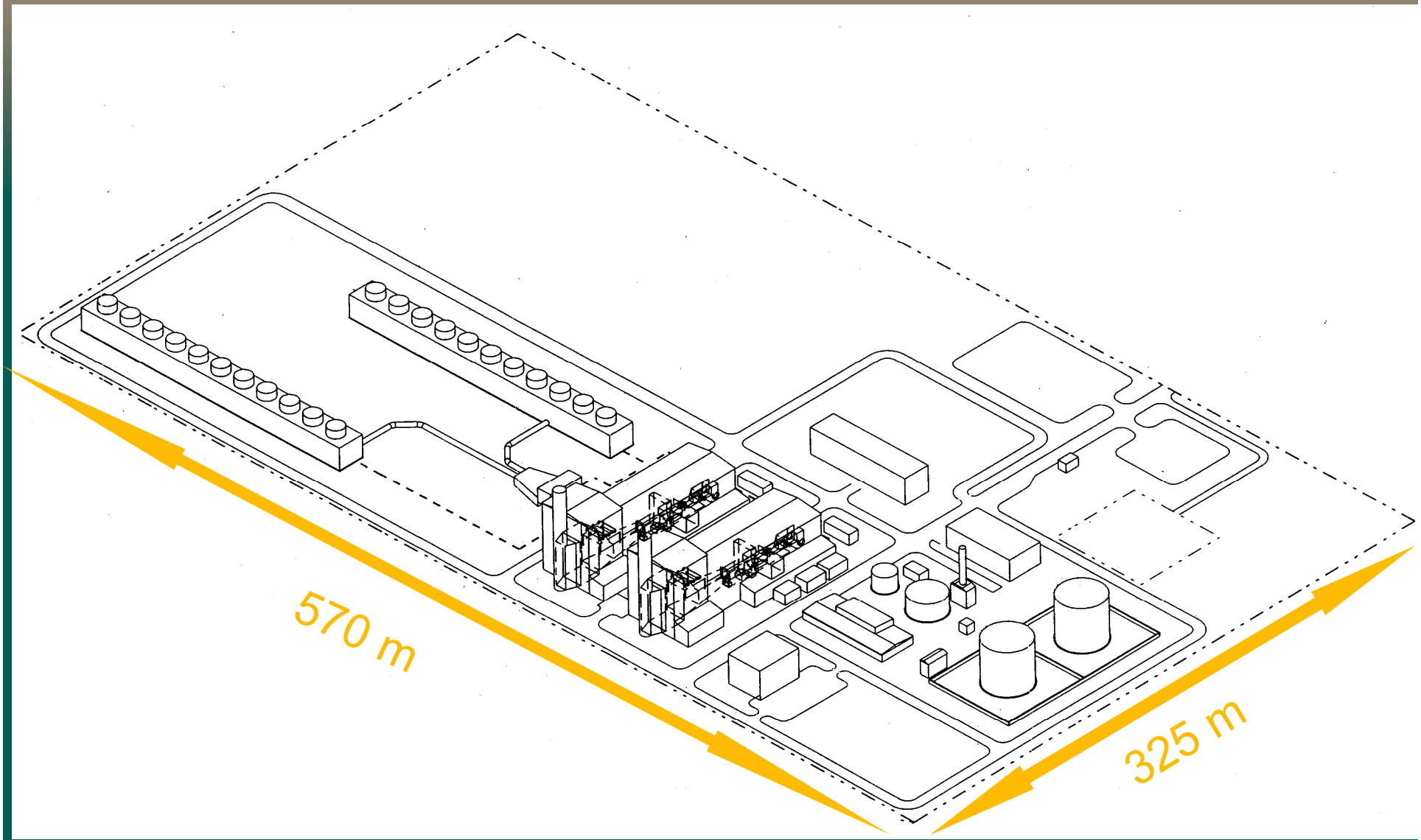


Plant area approx. 150 x 180 m

excluding cooling water site requirements

NamPower

Kudu 800 MW Isometric View

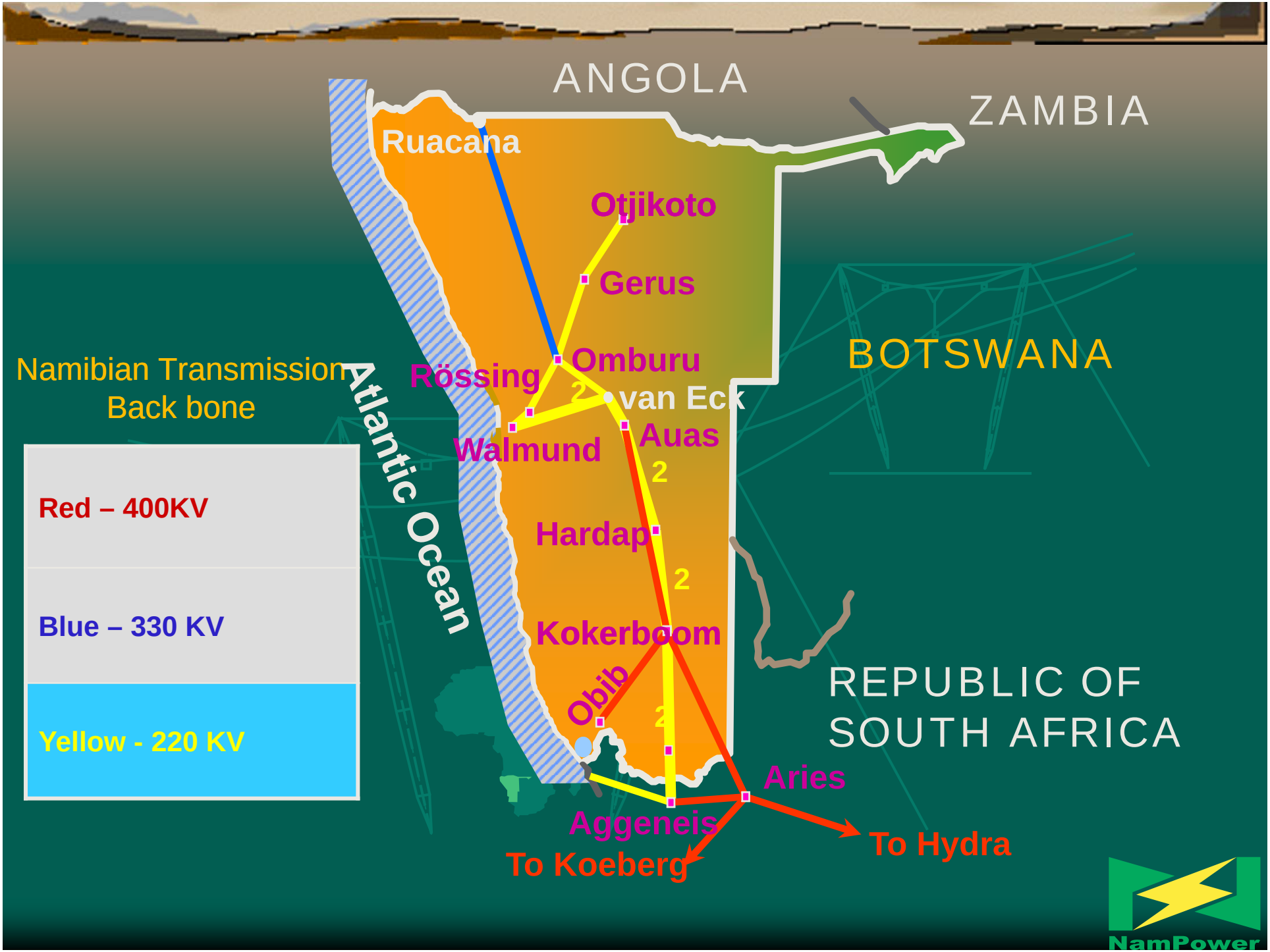


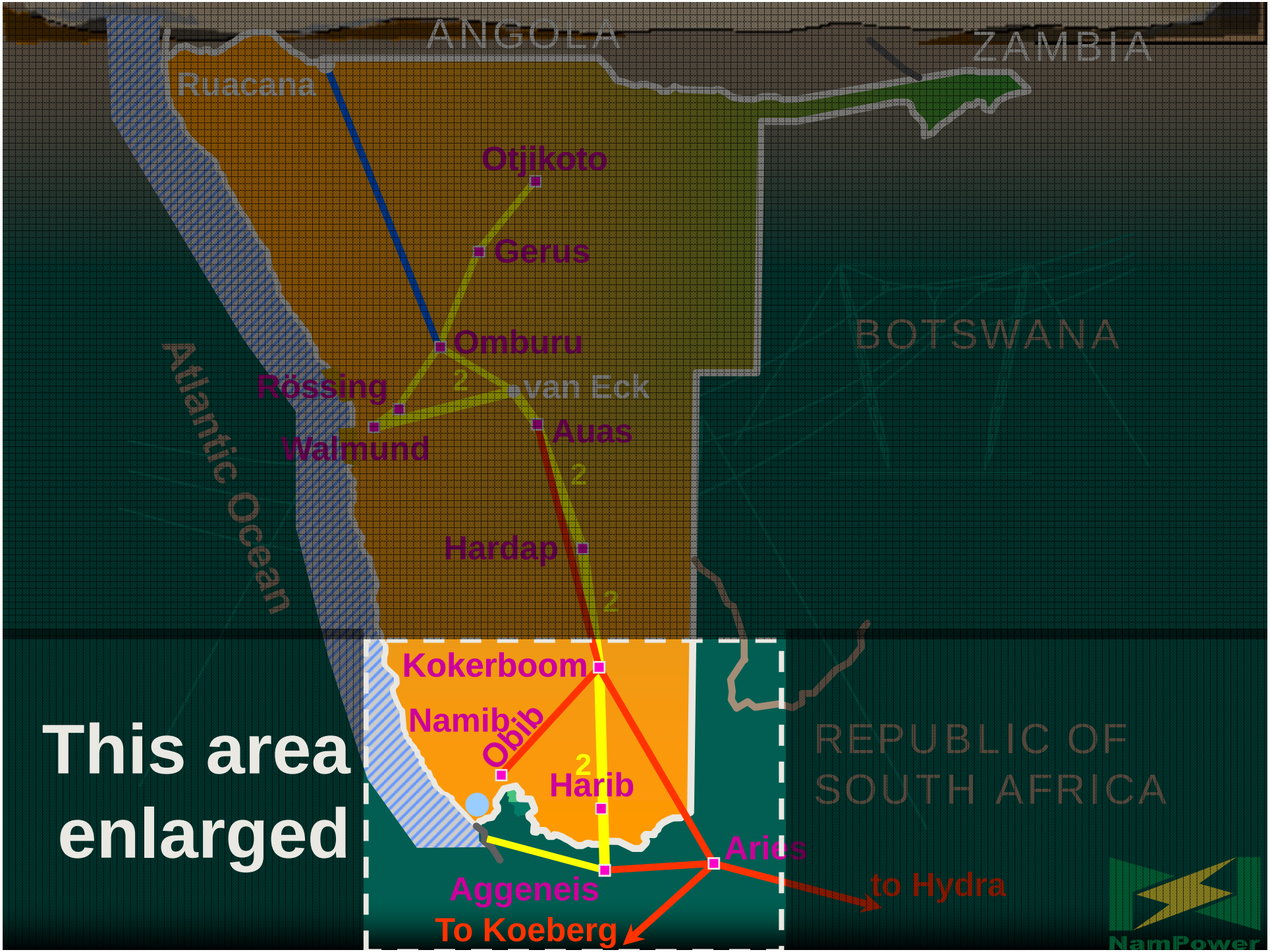
Examples CCGT Plants

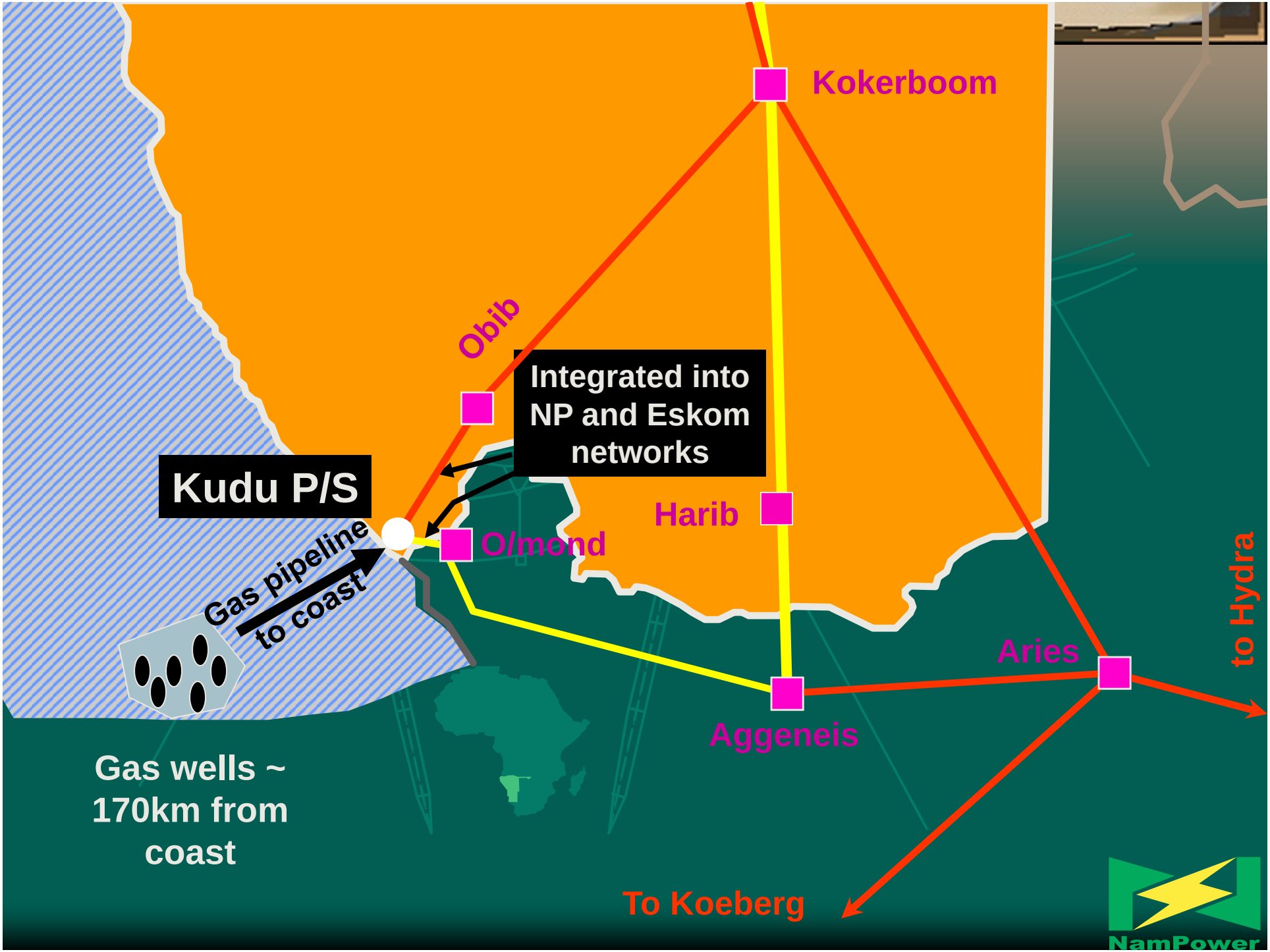
NamPower

Transmission Integration of Uubvley Power Station

NamPower


ANGOLA
ZAMBIA
BOTSWANA
REPUBLIC OF SOUTH AFRICA
Atlantic Ocean
Ruacana
Otjikoto
Gerus
Omburu
Rössing
2
van Eck
Auas
Walmund
2
Hardap
2
Kokerboom
Obib
2
Aries
Aggeneis
To Hydra
To Koeberg
Namibian Transmission Back bone
Red – 400KV
Blue – 330 KV
Yellow - 220 KV
NamPower


ANGOLA
ZAMBIA
Ruacana
Otjikoto
Gerus
Omburu
Rössing
van Eck
Walmund
Auas
Hardap
Atlantic Ocean
BOTSWANA
Kokerboom
Namib
Obib
Harib
REPUBLIC OF
SOUTH AFRICA
Aries
to Hydra
Aggeneis
To Koeberg
This area
enlarged
NamPower


Kokerboom
Obib
Integrated into NP and Eskom networks
Kudu P/S
Harib
O/mond
Gas pipeline to coast
Aries
to Hydra
Aggeneis
Gas wells ~ 170km from coast
To Koeberg
NamPower

Transmission Integration

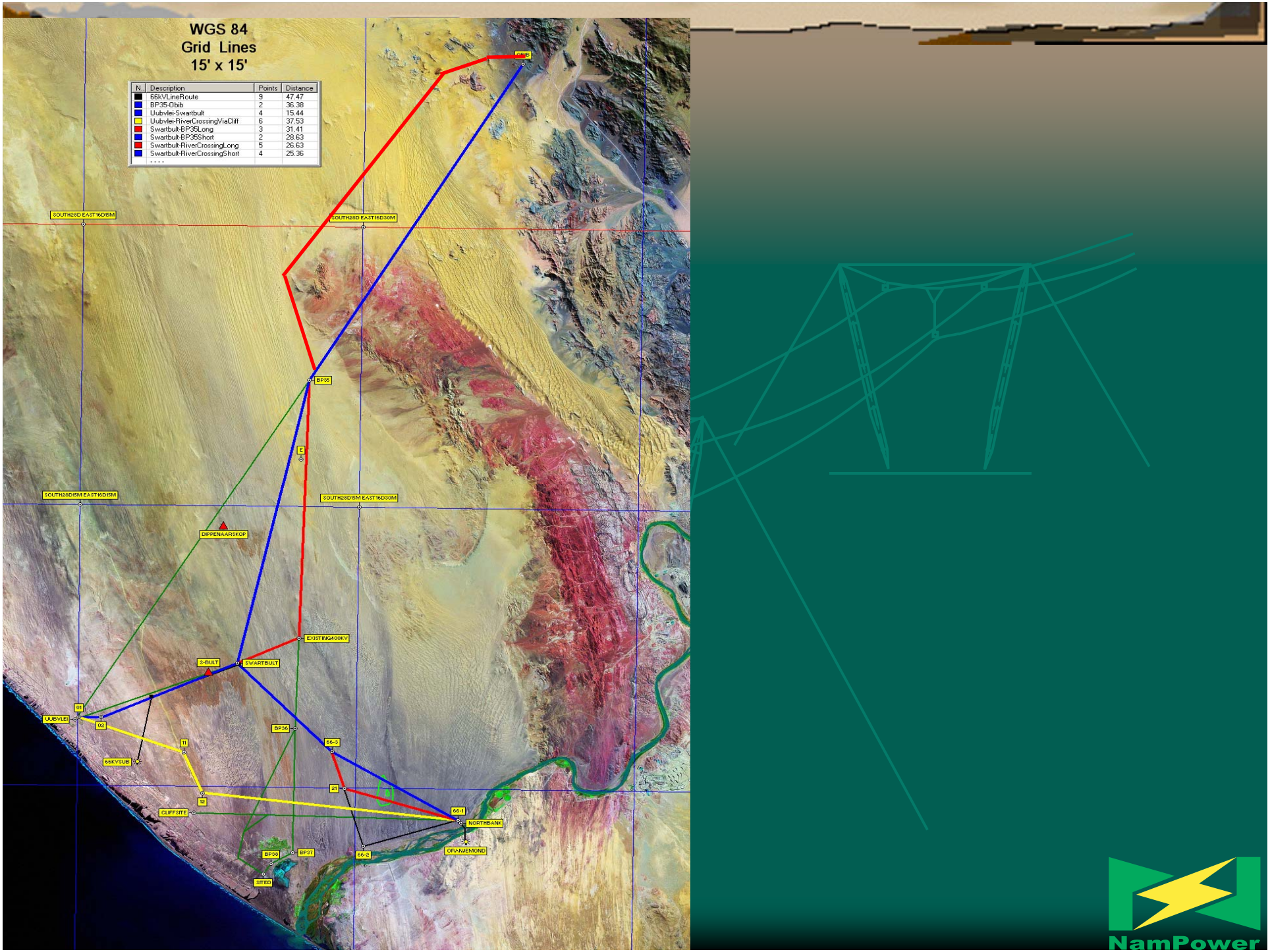
- 1st 800 MW
  - Connection to Namibian Grid
    - 400 kV via Obib to Kokerboom
  - Connection to Southern African Grid
    - 220 kV via Oranjemund to Aggeneis
    - Additional 400 kV to Namibian Border if required to integrate with Southern African grid
- 2nd 800 MW
  - Additional 400 KV lines to Southern African grid

NamPower

Environmental Impact Assessment: Power Station and Transmission Lines

- **Power Station**
  - **CCGT technology considered as “clean”**
  - **Pre-Environmental Impact Assessment Completed**
  - **EIA Consultant Appointed**
  - **EIA & EMP to be completed by June 2005**
- **Transmission Lines**
  - **1st 400 kV line and 200 kV line – EIA approved, ROD**
  - **2nd 400 kV line – Full EIA still to be conducted**

NamPower


WGS 84
Grid Lines
15' x 15'
N. Description Points Distance
66kVLineRoute 9 47.47
BP35-Obib 2 36.38
Uubvlei-Swartbult 4 15.44
Uubvlei-RiverCrossingViaCliff 6 37.53
Swartbult-BP35Long 3 31.41
Swartbult-BP35Short 2 28.63
Swartbult-RiverCrossingLong 5 26.63
Swartbult-RiverCrossingShort 4 25.36
SOUTH28D EAST16D15M
SOUTH28D EAST16D30M
BP35
SOUTH28D15M EAST16D15M
SOUTH28D15M EAST16D30M
DIPPENAARSKOP
EXISTING400KV
S-BULT
SWARTBULT
UUBVLEI
01
02
11
66KVSUB
BP36
66-3
21
12
CLIFFSITE
66-1
NORTHBANK
ORANJEMOND
BP38
BP37
66-2
SITED
NamPower

EIA AND EMP OF THE PROPOSED POWERLINES FROM UUBVLEY TO ORANJEMUND AND OBIB

1. Previous work

- Updating of EIA's of power lines linking the Power Station and Obib and Oranjemond respectively.

- Report submitted to MET for Record of Decision.

Contact :Stephanie van Zyl 061 223336 envirod@africaonline.com.na
www.NamPower.com.na

2. Scope:

This EIA covers the lines originating from Uubvley site. It will build on the earlier work, and the only new work that is required is that which addresses issues relevant to the areas that the new lines will traverse.

3. Study approach

- ✓ Scoping study
- ✓ Data collection
- ✓ Helicopter survey –select final proposed routes
- ✓ Detailed investigations
- ✓ Route evaluation and EIA

Contact :Stephanie van Zyl 061 223336 envirod@africaonline.com.na
www.NamPower.com.na

4. The Team

- ✓ Stephanie van Zyl – Team leader, report integration, socio-economic issues
- ✓ Dieter Noli - Archaeology
- ✓ Coleen Mannheimer - botany
- ✓ John Pallet, EEAN – ecology
- ✓ Chris van Rooyen, EWT - birds

5. Programme

- ✓ NamDeb Meeting and helicopter survey 15,16/3
- ✓ Public meeting 31/3
- ✓ Specialist studies 22/4
- ✓ Draft report submission to NamPower 29/4
- ✓ Public comment 16/5-17/6

Contact :Stephanie van Zyl 061 223336 envirod@africaonline.com.na
www.NamPower.com.na

APPENDIX 2

BIRD IMPACT ASSESSMENT

UPDATING OF AN ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN OF THE PROPOSED POWER LINES FROM THE KUDU GAS POWER STATION (SITE D) TO ORANJEMOND AND OBIB RESPECTIVELY

SPECIALIST CONSTRIBUTION:

BIRD IMPACT ASSESSMENT STUDY

Prepared by:

Chris van Rooyen
Endangered Wildlife Trust
Private Bag X11
Parkview
2122
Telephone: +27-11-4861102
Telefax: +27-11-4861506
Email: chrisv@ewt.org.za

Prepared for:

ENVIRO DYNAMICS
ENVIRONMENTAL MANAGEMENT CONSULTANTS

P O Box 20837
WINDHOEK
Namibia
Telephone: +264-61-223336
Telefax: +264-61-240309
E-mail: envirod@africaonline.com.na

TABLE OF CONTENTS

List of appendices

Glossary and definitions

Anti-collisions device:	A device used to mark the conductors and/or overhead shield wires of a powerline to prevent birds from colliding with it.
Collision:	The scenario where a bird fails to see the overhead shield wires and/or conductors of a powerline and collides with it in flight.
Conductors:	The energized aluminium cables that transport electrical current on a powerline.
Distribution line:	A high or medium voltage powerline with a nominal voltage between 11 and 132kV
Electrocution:	The scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components
Fluorescent marker:	A device that consists of a fluorescent tube that is placed on an energized conductor and ignited by the ambient electricity to glow.
ORMWP:	Orange River Mouth Wetland Park
Overhead shield wires:	Two thin, steel, non-energized conductors running at the top of a transmission structure to shield the energized conductors against lightning strikes.
Ramsar site:	The section of Orange River that has been designated to the List of Wetlands of International Importance under the Ramsar Convention.
Red Data species:	A species that is regarded as threatened in the South African Red Data book: Birds, and/or the draft Namibian Red Data list of birds, and/or the BirdLife International Red Data list of threatened birds of the world.
Transmission line: least 220kV or higher	A high voltage powerline with a nominal voltage of at

1 BACKGROUND

NamPower needs to construct 3 parallel power lines from the Kudu Power Station (800MW) development. For the first phase of the project, two 400kV lines will be needed to connect into the Namibian and South African grids respectively as well as a 220kV line that needs to connect the power station to the 220kV network at Oranjemond Substation. The second phase (another 800MW) would require an additional 400kV line to be constructed to connect to the South African power grid.

In a previous study conducted by the author in August 2004, the approved alignments for a 400kV and 220kV line were assessed from a bird impact perspective. It follows therefore that the background information on the birdlife in the study area conducted for that study is 100% relevant and applicable to this study, and will be treated as such. In essence, this study should be read as an addendum to the previous study. However, the relevant background information is repeated here for the benefit of the reader who might not have access to the previous study.

The previous EIA work needs to be updated because:

- The corridor will be wider than originally investigated (approximately 205m)
- There is a new route option being considered around Oranjemund to address visual and bird impacts.
- In case the present preferred site for the Power Station (site D) presents a fatal flaw the route for the transmission lines from the alternative site (Cliff Site) needs to be investigated.
- There have been developments regarding the status of the Sperrgebiet and the Orange River Mouth Conservation Area which could influence decisions on the routing of these transmission lines.

See **appendix A** for a map of the study area showing the various new alternatives for the powerlines.

The brief for this bird impact assessment study is as follows:

- Compare alternatives 1 and 2 from a bird impact assessment perspective
- Evaluate option 3 from bird impact assessment perspective

1.1 Description of typical impacts of transmission lines (220kV and bigger) on birds

1.1.1 1.1.1 Electrocutions

Electrocutions of birds on overhead lines are an emotional issue as well as an important cause of unnatural mortality of raptors and storks. It has attracted plenty of attention in Europe, USA and South Africa (APLIC 1994; Alonso & Alonso 1999; van Rooyen & Ledger 1999). However, in the context of overhead lines above 132 kV, electrocutions are not a major issue. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004a). Due to the large size of the clearances on most overhead lines of above 132kV, electrocutions are generally ruled out as even the largest birds cannot physically bridge the gap between dangerous components. In fact, transmission lines have proven to be beneficial to many birds, including species such as Martial Eagles *Polemaetus bellicosus*, Tawny Eagles *Aquila rapax*, African Whitebacked Vultures *Gyps africanus*, and even occasionally Verreaux's

Eagles *Aquila verreauxii* by providing safe nesting and roosting sites in areas where suitable natural alternatives are scarce (van Rooyen 2004b). Cape Vultures have also taken to roosting on powerlines in certain areas in large numbers (van Rooyen 2004a), while Lappetfaced Vultures are also known to using powerlines as roosts, especially in areas where large trees are scarce (pers.obs.). Due to the non-existent risk that electrocution poses on large transmission lines such as the lines that form the subject of this report, this particular issue need not be further discussed in this study.

1.1.2 1.1.2 Collisions

Collisions are the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004a). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which make it difficult for them to take the necessary evasive action to avoid colliding with powerlines (van Rooyen 2004a, Anderson 2001).

Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. In the period August 1996 to March 2003, seventy-four percent of collision mortalities on Eskom transmission lines that were recorded on the EWT's central incident register of powerline mortalities were South African Red Data species (van Rooyen 2003). This trend has continued to the present; the figure currently stands at 76% (van Rooyen 2004c).

Table 1: Red Data species (Barnes 2000) collision mortalities on Eskom transmission lines between August 1996 and March 2003, recorded on the EWT central incident register (van Rooyen 2003):

Species	**Number**
Ludwig's Bustard *Neotis ludwigii*	77
Blue Crane *Anthropoides paradisea*	47
White Stork *Ciconia ciconia* (not included in the SA Red Data book, but protected under the Bonn Convention on Migratory Species)	25
Greater Flamingo *Phoenicopterus ruber*	22
Kori Bustard *Ardeotis kori*	9
Cape Griffon *Gyps coprotheres*	9
Grey Crowned Crane *Balearica regulorum*	8
Stanley's Bustard *Neotis denhami*	4
Secretarybird *Sagittarius serpentarius*	3
Lesser Flamingo *Phoenicopterus minor*	3
African Whitebacked Vulture *Gyps africanus*	2
Tawny Eagle *Aquila rapax*	1
Martial Eagle *Polemaetus bellicosus*	1
Lappetfaced Vulture *Torgos tracheliotus*	1
Corncrake *Crex crex*	1

Although significant in itself, the figures are not a true reflection of the extent of the problem, because none of the collision localities were closely monitored over a substantial period of time. Where long term monitoring did happen, the picture is disturbing. In one instance, where bi-monthly monitoring did take place, a single 10 km section of 132kV distribution line killed 59 Blue Cranes, 29 Ludwig's Bustard, and 13 White Storks in a three year period (van

Rooyen unp. data). In 2004, fifty-four Blue Crane carcasses were discovered near Graaf-Reinett in the Northern Cape province under 3.7km of distribution line.

Data collected in the Northern Cape Province between 1997 and 1999 provides further evidence of the gravity of the problem. During an initial clearing of transects, a total of 194 large bird carcasses were found under 40km of Transmission line (220 and 400kV) near De Aar in the Northern Cape. Subsequent monitoring of 140 km of powerlines (transects of 10km each from 22kV up to 400kV) in the same area over a period of 12 months produced another 196 carcasses (mostly cranes and bustards), the majority under transmission lines (Anderson 2001).

The Red Data species vulnerable to powerline collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. A good example of this is the two flamingo species that occur in southern Africa, which have experienced erratic breeding success at a few critical breeding areas (Williams & Velasquez 1997). These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term. Many of the anthropogenic threats to these species are non-discriminatory as far as age is concerned (e.g. habitat destruction, disturbance and powerlines) and therefore contribute to adult mortality, **and it is not known what the cumulative effect of these impacts could be over the long term**. Using computer modeling, the South African Crane Working Group recently estimated that an annual mortality rate of 150 adult Blue Cranes could reduce the eastern population of Blue Cranes (app. 2000 individuals in Mpumalanga and KwaZulu-Natal) by 90% by the end of the 21st century (McCann *et.al.* 2001). At that stage the population would be functionally extinct.

From the figures quoted above, it is clear that powerlines are a major contributory cause of avian mortality among powerline sensitive species, especially Red Data species. Furthermore, the cumulative effects of powerlines and other sources of unnatural mortality might only manifest itself decades later, when it might be too late to reverse the trend. It is therefore imperative to reduce any form of unnatural mortality in these species, regardless of how insignificant it might seem at the present moment in time.

1.1.3 1.1.3 Habitat destruction and disturbance

During the construction phase and maintenance of powerlines, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude, both through modification of habitat and disturbance caused by human activity. This issue is not likely to have a major impact in this instance, as the vegetation is such that it would not require extensive clearing. It is also unlikely that the construction of the powerlines will cause major disturbance, as they are routed away from the major roost sites in the study area. One exception is the construction of the lines where they cross the Orange River, where they could impact on Peregrine Falcons breeding on cliffs nearby (see discussion below).

1.2 Description of receiving environment

The currently proposed site for the Kudu power plant is site D (see attached map **appendix A**). The site is bounded on the east and south by the Pink Pan, which is a naturally occurring hyper-saline pan, and on the west by mine workings. Oranjemund lies 2km to the north and Alexander Bay is 7km to the East South-East. The site is some 2.5 km from the coast and 7km away from the Orange River mouth. The site is located just outside the boundaries of the Orange River Mouth Wetland Park (ORMWP). The various alternatives are as follows:

- **Alternative~~Option~~ 1** is to bring the route from the site D in an easterly direction between the Oranjemund town and the Pink Pan towards the point where the lines will cross the Orange River opposite Oranjemond substation
- **Alternative 2** would be to take the power lines from site D around Oranjemund in a north-westerly direction and then eastwards towards the point where they will cross the Orange River opposite Oranjemond substation.
- **Alternative 3** would be a small deviation from Alternative 2 to link the route to the Cliff Site (north-west of Oranjemund; this option will be used only if Site D is environmentally and technically unsuitable for the development of the Power Station).

1.2.1 1.2.1 Bird habitat and diversity within the ORMWP

The ORMWP is at the end point of the Orange River, one of southern Africa's largest and most important rivers. It is one of the few perennial wetlands on the arid western coastline of southern Africa and has a variety of wetland habitats and supports a high variety of waterbirds. In 1991 and 1995, South Africa and Namibia respectively designated the section of river west of the Oppenheimer Bridge to the List of Wetlands of International Importance under the Ramsar Convention. It is also recognized as an Important Bird Area (Barnes 1998). Although the number of waterbirds has decreased since the site was first designated as a Ramsar site in 1991, it still meets three of the four Ramsar criteria under which it was originally designated. In particular it continues to support more than 1% of the southern African and global populations of several waterbird species as is demonstrated in table 1 below (Anderson *et. al.* 2003).

Table 1: The maximum number of birds recorded during 13 surveys since December 1995, estimated Southern African and global populations for these species, and the proportion of these populations which occur at the Orange River mouth. Species which meet the 1% global threshold are shaded (Anderson *et. al.* 2003).

Species	No. of birds	Southern African population	Proportion of SA population	Global Population	Proportion of global population
Black-Necked Grebe *Podiceps nigricollis*	125	>10 000	<1.3%	145,000	>0.09%
Great White Pelican *Pelecanus onocrotalus*	473	12,000	3.9%	>150 000	<0.3%
Cape Cormorant *Phalacrocorax capensis*	984	145,022	1.4%	145,022	1.4%

Lesser Flamingo *Phoenicopterus minor*	1,031	40 000-60 000	1.7-2.6%	2 000 000-6 000 000	<0.05%
Greater Flamingo *Phoenicopterus rubber*	700	47 427-55 000	1.3-1.5%	800,000	<0.09%
South African Shelduck *Tadorna cana*	516	42,000	1.2%	42,000	1.2%
Cape Shoveller *Anas smithii*	373	20 000-50 000	0.7-1.9%	20 000-50 000	0.7-1.9%
Chestnut-Banded Plover *Charadrius pallidus*	97	11,192	0.9%	12,792	0.8%
Pied Avocet *Recurvirostra avosetta*	891	10 000-20 000	4.5-8.9%	132 000-337 000	0.3-0.7%
Curlew Sandpiper *Calidris ferruginea*	1,666	74 600-149 200	1.1-2.2%	1,000,000	0.17%
Kelp Gull *Larus dominicanus*	1,098	>22 000	5.0%	>22 000	5.0%
Hartlaub's Gull *Larus hartlaubii*	707	>30 000	2.4%	>30 000	2.4%
Caspian Tern *Sterna caspia*	165	1,500	11.0%	53 480-164 480	0.1-0.3%
Swift Tern *Sterna bergii*	344	6,000	5.7%	15,000	2.3%
Damara Tern *Sterna balaenarum*	58	13,500	0.4%	13,500	0.4%

The ORMWP is an important refuge for several Red Data species, as can be seen in the table 2 (Anderson *et. al*. 2003):

Table 2: Waterbirds regularly recorded at the Orange River mouth which are listed in the South African (Barnes 2000), Namibian (Simmons *et al.* in prep) and international (BirdLife International 2000) Red Data books.

Waterbird species		**South Africa**	**Namibia**	**International**
Great White Pelican	*Pelecanus onocrotalus*	Near-threatened	Endangered	-
Cape Cormorant	*Phalacrocorax capensis*	Near-threatened	-	Near-threatened
Sacred Ibis	*Threskiornis aethiopicus*	-	Vulnerable	-
Glossy Ibis	*Plegadis falcinellus*	-	Vulnerable	-
Hadeda Ibis	*Bostrychia hagedash*	-	Vulnerable	-
Greater	*Phoenicopterus ruber*	Near-threatened	Endangered	-

Flamingo				
Lesser Flamingo	*Phoenicopterus minor*	Near-threatened	Endangered	Near-threatened
African Fish Eagle	*Haliaetus vocifer*	-	Endangered	-
African Marsh Harrier	*Circus ranivorus*	Vulnerable	Vulnerable	-
Chestnut-banded Plover	*Chadadrius pallidus*	Near-threatened	Vulnerable	-
Hartlaub's Gull	*Larus hartalaubii*	-	Vulnerable	-
Caspian Tern	*Sterna caspia*	Near-threatened	Vulnerable	-
Swift Tern	*Sterna bergii*	-	Vulnerable	-
Damara Tern	*Sterna balaenarum*	Endangered	Endangered	Near-threatened

Waterbirds use a variety of areas in the Ramsar site, but large concentrations have been recorded at islets in the river floodplain, the oxidation ponds, on the sandspit and exposed tidal sand bank, and the lower end of the salt marsh. During six recent surveys, the largest proportion of waterbirds was counted at two wetland areas, namely the saltmarsh (12.1%-37.3%) and the north bank, adjacent islands and Namibian beach area (24.5% - 44.9%). The peripheral wetlands (Pink Pan, Yacht Club, lucerne fields pan) support relatively fewer birds (Anderson 2003).

Although the Pink Pan does not usually support huge numbers of birds, Red Data species have been recorded there during bi-annual counts, including Great White Pelicans, Lesser Flamingos and Swift Terns (see **appendix B**, Anderson & Kolberg unp.data).

Other important habitat outside the Ramsar site (between Hohenfels and the Oppenheimer Bridge) is the rocky outcrops and cliffs in the vicinity of the current 66kV river crossing that border the river and support breeding Peregrine Falcons (M. Anderson pers.comm). This is used by a variety of birds (including Lanner Falcons *Falco biarmicus*, Spurwinged Geese *Plectropterus gambensis* and Egyptian Geese *Alopochen aegyptiacus*) for perching, and (presumably) roosting (pers.obs). There is also extensive traffic up and down the river channels and sandbanks in this section, including South African Shelducks, Egyptian Geese, Spurwinged Geese, Grey Herons *Ardea cinerea*, African Spoonbill *Platalea alba*, Cattle Egret *Bubulcus ibis*, Hadeda Ibis *Bostrychia hagedash* and Caspian Terns (pers. obs). In 1997, a Great White Pelican collision was recorded at the 66kV river-crossing (Anderson unp.data), and this species was recorded in this area during bi-annual counts (see **appendix C**, Anderson & Kolberg unp.data).

Another important habitat (for purposes of this study) is the dredge ponds along the coast in the mined out areas (see **appendix D**). Flamingos have been observed on these ponds by Namdeb staff (M. Soroczynski pers. comm.). It is very probable that movement between these areas and the Pink Pan take place.

1.3 Structure types

The towers around Oranjemund will mostly be self supporting suspension and strain towers. They are bulky for extra strength around the bends (see Figure 1 below). The spacing between these towers will be 350 to 400m. The towers on the straight sections will be cross-rope suspension towers (see Figure 2 below).

Figure 1: Self supporting tower

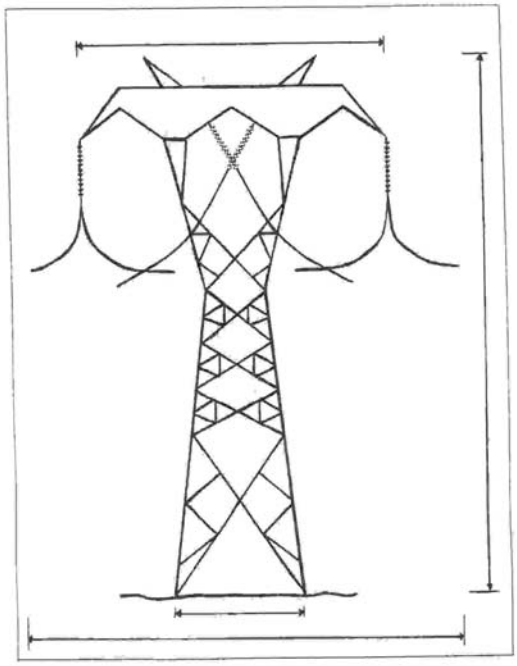
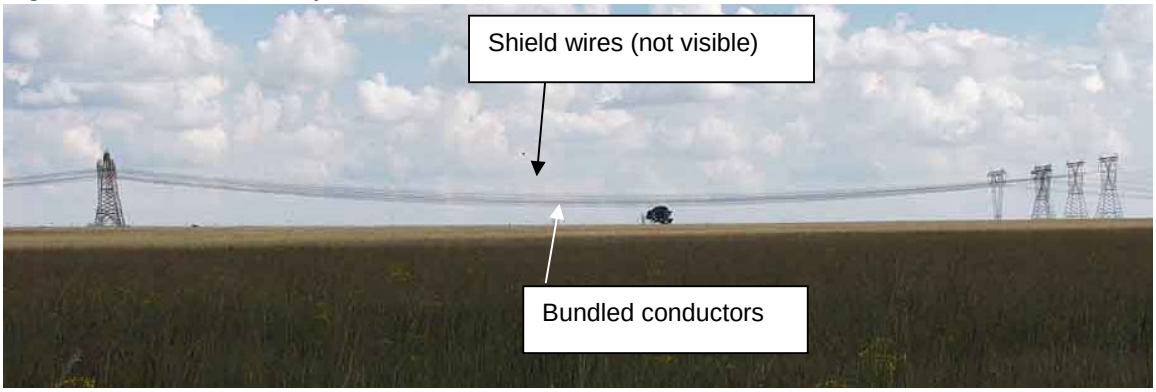


Figure 2: Cross-rope suspension tower

These structures all have overhead shield wires for lightning protection. It is generally accepted that the shield wire is the main threat to flying birds (APLIC 2004), as it is a thin steel wire approximately 14mmin diameter. This makes it a lot less visible than the thick bundled conductors as is demonstrated in figure 3 below. **None of the structures pose any electrocution risk to birds.**

Figure 3: Relative visibility of bundled conductors versus overhead shield wires



2 PREDICTIVE METHODS

In predicting impacts of a proposed powerline on birds, a combination of science and field experience is required.

The methodology used to predict impacts in the current study was as follows:

- The paper published by Anderson *et. al*. (2003) "Waterbird populations at the Orange River mouth from 1980-2001: a re-assessment of its Ramsar status": Ostrich 74(3&4): 159-172, was extensively used to obtain accurate data of bird numbers and species composition in the ORMWP. This was supplemented with additional unpublished data from Mark Anderson and Holger Kolberg.

- The area was visited for two days in July 2004 and sections of the proposed powerline routes were travelled with a vehicle and on foot to obtain a first-hand perspective of the proposed routes and the birdlife.
- Additional information on bird populations and movements were obtained from anecdotal observations by Namdeb employees at Oranjemund and from Trygve Cooper, MET officer in the Sperrgebiet.
- The impacts were predicted on the basis of experience by the author in gathering and analysing data on wildlife impacts caused by powerlines throughout southern Africa since 1996.

3 UNCERTAINTIES IN PREDICTING RESULTS

The following factors may potentially detract from the accuracy of the predicted results:

- Very little quantitive data could be obtained on the movement and flight paths of birds in the ORMWP. This had to be predicted on the basis of experience and knowledge of the general behaviour of the species in question, as well as the anecdotal observations by several observers and personal observations during the field visit.
- The number and species composition of the birds in the ORMWP fluctuates all the time, making it difficult to predict impacts with a high level of confidence.

4 GAPS IN BASELINE DATA

Perhaps the biggest gap in the baseline data is the lack of long term, verified data on avian impacts caused by the existing 66kV line in the ORMWP, especially where it crosses the Orange River.

5 EXPECTED IMPACTS AND EVALUATION

A detailed analysis of potential impacts on Red Data and other birds is provided in table form in **appendix E1 and E2**. Below, a general discussion follows.

Table 3: Evaluation of expected impacts

Bird collisions with the conductors and the overhead shield wires at the Pink Pan and Orange River crossing	**CONSTRUCTION**		**OPERATION**	
	Before Mitigation	**After Mitigation**	**Before Mitigation**	**After Mitigation**
Status	N/A	N/A	Negative	Negative
Extent	N/A	N/A	Local	Local
Duration	N/A	N/A	Long term	Long term
Intensity	N/A	N/A	Medium to high	Low to medium
Probability	N/A	N/A	Highly probable	Probable
Mitigation	N/A	N/A	N/A	Limited to Satisfactory
Overall significance	N/A	N/A	Moderate	Low

Disturbance of breeding raptors at the Orange River crossing	CONSTRUCTION		OPERATION	
	Before Mitigation	**After Mitigation**	**Before Mitigation**	**After Mitigation**
Status	Negative	Negative	N/A	N/A
Extent	Local	Local	N/A	N/A
Duration	Short term	Short term	N/A	N/A
Intensity	Medium to high	Low to medium	N/A	N/A
Probability	Highly probable	Improbable if construction is avoided during breeding season. Probable if construction cannot be avoided during breeding season.	N/A	N/A
Mitigation	N/A	Limited to Satisfactory, depending if construction during breeding season can be avoided.	N/A	N/A
Overall significance	Moderate	Low	N/A	N/A

5.1 Collisions

The biggest potential threat posed by the proposed powerlines is collision with the overhead shield wires. There are factors present that both aggravate and mitigate the avian collision risks.

5.1.1 5.1.1 Alternative 1

Factors that increase the risk of bird collisions:

- The proposed alignment lines run close the Pink Pan. It is likely that there will be flamingo movement between the dredge ponds on the coast and the pan. The presence of flamingos in the dredge ponds have been confirmed by Namdeb staff (M. Soroczynski pers. comm.). This will place the powerlines in a potential flight path of the flamingos (see appendix A).
- Although the Pink Pan has generally fewer birds than some of the other wetlands in the ORMWP, it still has considerable numbers of powerline sensitive Red Data species present e.g. flamingos and Great White Pelicans were present in notable numbers during the counts in 1996 and 1999.

- The area is prone to heavy fog which could obscure the powerlines and increase the risk of collision.
- The alignment crosses over the Orange River is directly in the flight path of birds commuting up and down the river (see appendix A), including Peregrine Falcons *Falco peregrinus* hunting Speckled Pigeons *Columba guinea* in the vicinity of the river crossing. Peregrine collisions with powerlines have been recorded in South Africa (van Rooyen unp.data).
- Flamingos often fly at night, thereby increasing the risk of collisions (Williams & Velasquez 1997).

Factors that decrease the risk of bird collisions:

- The alignment will not be in the way of what is likely to be the more important flight paths, namely between the Ramsar site and the Pink Pan.
- Placing the powerlines adjacent to each other probably increases the overall visibility of the lines.
- The Pink Pan and the area upstream from the Oppenheimer Bridge harbour relatively few birds compared to some of the other wetlands in the system, thereby decreasing the risk that large numbers of birds will be killed.

5.1.2 5.1.2 Alternative 2

Factors that increase the risk of bird collisions:

- The same as for Alternative 1. Although the proposed alignment does not skirt the Pink Pan it is still partly crosses a potential flight path between the dredge ponds on the coast and the pan.

Factors that decrease the risk of bird collisions:

- The same as for Alternative 1.

5.1.3 5.1.3 Alternative 3

Factors that increase the risk of bird collisions:

- The alignment crosses over the Orange River is directly in the flight path of birds commuting up and down the river (see appendix A).

Factors that decrease the risk of bird collisions:

- The proposed alignment misses the potential flight paths along the coast and between the coast and Pink Pan.

5.2 Disturbance

Disturbance could be a problem with all three alignments at the proposed river crossing, where a pair of Peregrine Falcons roosts and most likely breed (M. Anderson pers. comm.). The cliff face below the powerline is well marked with whitewash, indicating long term occupancy of the cliff by the falcons (pers. obs).

6 CONCLUSIONS

The proposed alignments 1 and 2 pose a largely similar, limited potential risk of collision to several waterbird species as well as a few raptor species. Importantly, several of these are Red Data species, either in South Africa or Namibia, with a few being of international concern. From a bird impact assessment perspective, the two alignments are rated as equal. Alignment 3 also poses a collision risk, but only at the Orange River crossing. It is a more preferred option than alignment 1 and 2. All three alignments pose a risk of disturbance to breeding raptors at the Orange River crossing during construction.

A summary of the conclusions is provided in the Impacts Summary Table in **appendix F**.

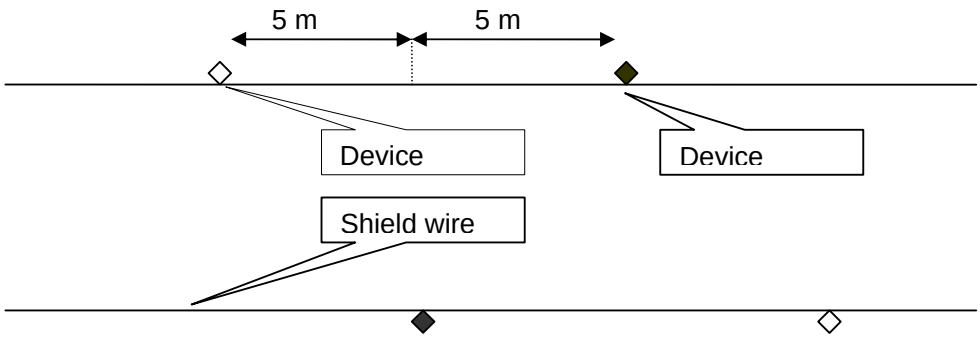
7 RECOMMENDED MITIGATION MEASURES

7.1 Overhead shield wires

Should either alignment 1 or 2 be selected, it is recommended that the overhead shield wires of the spans adjacent to the Pink Pan be marked with anti-collision devices (see **appendix A**).

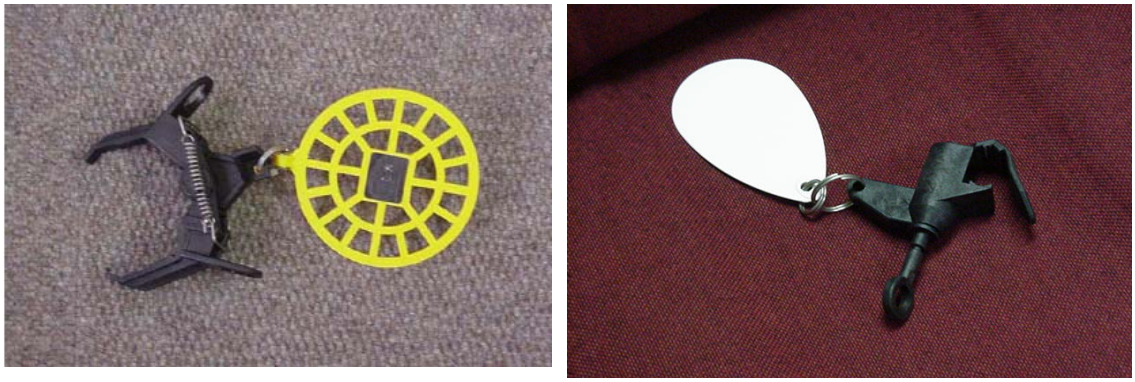
Research in the Netherlands has shown that spacing intervals have a major influence on the effectiveness of anti-collision devices (Koops & de Jong 1982, as cited in APLIC 1994). In South Africa, the same has been found (Anderson 2001). See figure 4 below for a suggested marking method with devices.

Figure 4: Marking method with anti-collision devices on overhead ground wires (viewed from above). Note that both the wires shown above are the shield or ground wires (flappers staggered).



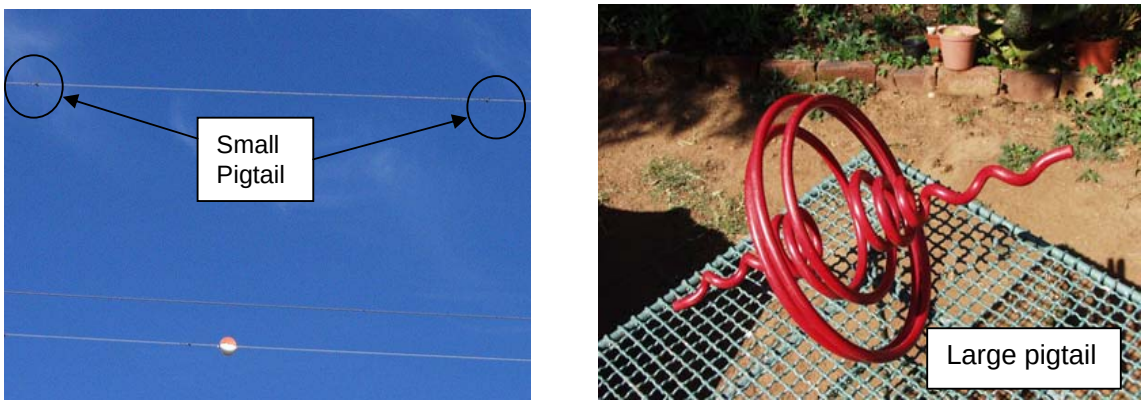
There are several devices available in southern Africa for the marking of powerlines. Some are dynamic devices (usually called bird flappers), and some are static. Both have advantages and disadvantages. Dynamic devices are very effective in reducing collisions as the birds seem to see them very well (van Rooyen unp. data), probably because of the movement that attracts attention. The disadvantage of dynamic devices is that they are subject to extensive wear and tear, inevitably limiting the lifespan of the device. This has obvious cost implications if a line needs to be re-marked at intervals of a few years. No solution to that problem has been found to date and it must be accepted as a constraint. Figure 5 shows examples of bird flappers currently available on the market.

Figure 5: Examples of bird flappers



Static devices are mechanically more durable because they lack the element of wear and tear that moving parts inevitably have. However, in South Africa, static devices, particularly the so called Bird Flight Diverter (also known as the pigtail) has had limited success (Anderson 2001). The most obvious reason seems to be that they are simply less visible, especially the small ones (see figure 4). A better option would be to use the bigger pigtail (see figure 4, right), although it is still not the preferred option.

Figure 6: The overhead shield wires of the existing Namdeb 66kV line marked with small pigtails.

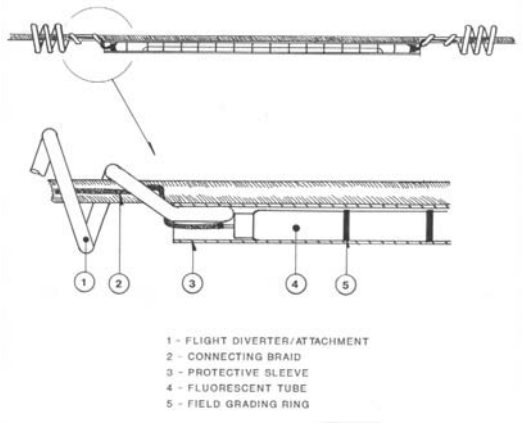


Research to find a compromise between durability and visibility is ongoing in South Africa. **It is therefore recommended that the Endangered Wildlife Trust is consulted before a final decision is taken on the type of device to be used in this instance, as new products might be available by the time the line is constructed**.

7.2 Conductors

The conductors of the lines adjacent to the Pink Pan should be marked with fluorescent markers to reduce the risk of nocturnal flamingo collisions. Currently, only one product is available on the market, the Mace Bird Lite (see figure 7 and appendix A).

Figure 7: The Mace Bird Lite can be used to reduce nocturnal collisions



7.3 Disturbance

It is recommended that prior to construction taking place at the Orange River crossing, the presumed Peregrine breeding site is monitored to establish how big the risk of disturbance to the birds will be. Should it turn out that the risk of disturbance to the breeding birds is significant, appropriate mitigation measures to limit the risk of disturbance to the birds must be agreed upon between NamPower and the Northern Cape Conservation Services. Ideally, no construction should take place during the birds' breeding season from September to October.

8 ENVIRONMENTAL MANAGEMENT PLAN

It is recommended that the sections of powerline that have been marked with anti-collision devices should be inspected **monthly for a period of one year** afterwards to assess the effectiveness of the devices. Two issues should be addressed:

- Carcasses of birds under the marked sections must be recorded.
- The status of the devices must be recorded (e.g. have they shifted, are the fluorescent markers still glowing, have any devices become dislodged).

9 ACKNOWLEDGEMENTS

Mark Anderson is thanked for his invaluable help in putting this study together.

10 REFERENCES

Alonso, J. A., Alonso, J. C., 1999. Mitigation of bird collisions with transmission lines through groundwire marking. In: Ferrer M and Janss F E (eds), Birds and powerlines, pp113 – 124, Quercus, Madrid, Spain.

Anderson, M.D., 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

Anderson, M.D., Kolberg, H., Anderson, P.C., Dini, J., Abrahams, A. 2003. Waterbird populations at the Orange River mouth from 1980-2001: a re-assessment of its Ramsar status. Ostrich 74(3&4): 159-172.

Barnes, K.N., (ed.) 1998. The Important Bird Areas of southern Africa. Pp 109-111. BirdLife South Africa, Johannesburg.

Barnes, K.N., (ed.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

Birdlife International., 2000. Threatened Bird of the World. Lynx Edicions and BirdLife International. Barcelona and Cambridge.

Hobbs, J.C.A., & Ledger J.A., 1986a. The Environmental Impact of Linear Developments; Powerlines and Avifauna. Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986.

Hobbs, J.C.A., & Ledger J.A., 1986b. Powerlines, Birdlife and the Golden Mean. Fauna and Flora 44:23-27.

Kruger, R., Van Rooyen, C.S., 1998. Evaluating the risk that existing powerlines pose to large raptors by using risk assessment methodology: the Molopo Case Study. 5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.

Kruger, R., 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. M. Phil. Mini-thesis. University of the Orange Free State. Bloemfontein. South Africa.

Ledger, J., 1983. Guidelines for Dealing with Bird Problems of Transmission lines and Towers. Escom Test and Research Division Technical Note TRR/N83/005.

Ledger, J.A., Annegarn H.J., 1981. Electrocution Hazards to the Cape Vulture *(Gyps coprotheres)* in South Africa. Biological Conservation 20:15-24.

Ledger, J.A., 1984. Engineering Solutions to the Problem of Vulture Electrocutions on Electricity Towers. The Certificated Engineer 57:92-95.

Ledger, J.A., Hobbs J.C.A., Smith T.V., 1992. Avian Interactions with Utility Structures: Southern African Experiences. Proceedings of the International Workshop on Avian Interactions with Utility Structures, Miami, Florida, 13-15 September 1992. Electric Power Research Institute.

McCann, K., Morrison, K., Byers, A., Miller, P. & Friedman, Y. (eds). 2001. Population and Habitat Viability Assessment for the Blue Crane *(Anthropoides paradiseus).* Conservation Breeding Specialist Group (SA), Endangered Wildlife Trust, Johannesburg.

Simmons, R.E., Brown, C.J., Williams, A.J. (In prep.) Birds to watch in Namibia: a red list. National Biodiversity Programme. Ministry of Environment and Tourism. Namibia.

Van Rooyen, C.S., Ledger, J.A., 1999. Birds and utility structures: Developments in southern Africa. Pp 205-230 in Ferrer, M. & G..F.M. Janns. (eds.) Birds and Powerlines. Quercus, Madrid, Spain.

Van Rooyen, C.S., Taylor, P.V., 1999. Bird Streamers as probable cause of electrocutions in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina

Van Rooyen, C.S., 1998. Raptor mortality on powerlines in South Africa. 5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.

Van Rooyen, C.S., 1999**.** An overview of the Eskom-EWT Strategic Partnership in South Africa. EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999, Charleston, South Carolina.

Van Rooyen, C.S., 2000. An overview of Vulture Electrocutions in South Africa. Vulture News 43: 5-22. Vulture Study Group, Johannesburg, South Africa.

Van Rooyen, C.S., 2003. Mitigation Programme for Avian Collisions with Eskom Transmission Lines. Unpublished Progress Report, September 2003. Endangered Wildlife Trust, Johannesburg, South Africa.

Van Rooyen, C.S., 2004a. The Management of Wildlife Interactions with overhead lines. In: The Fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg 2004.

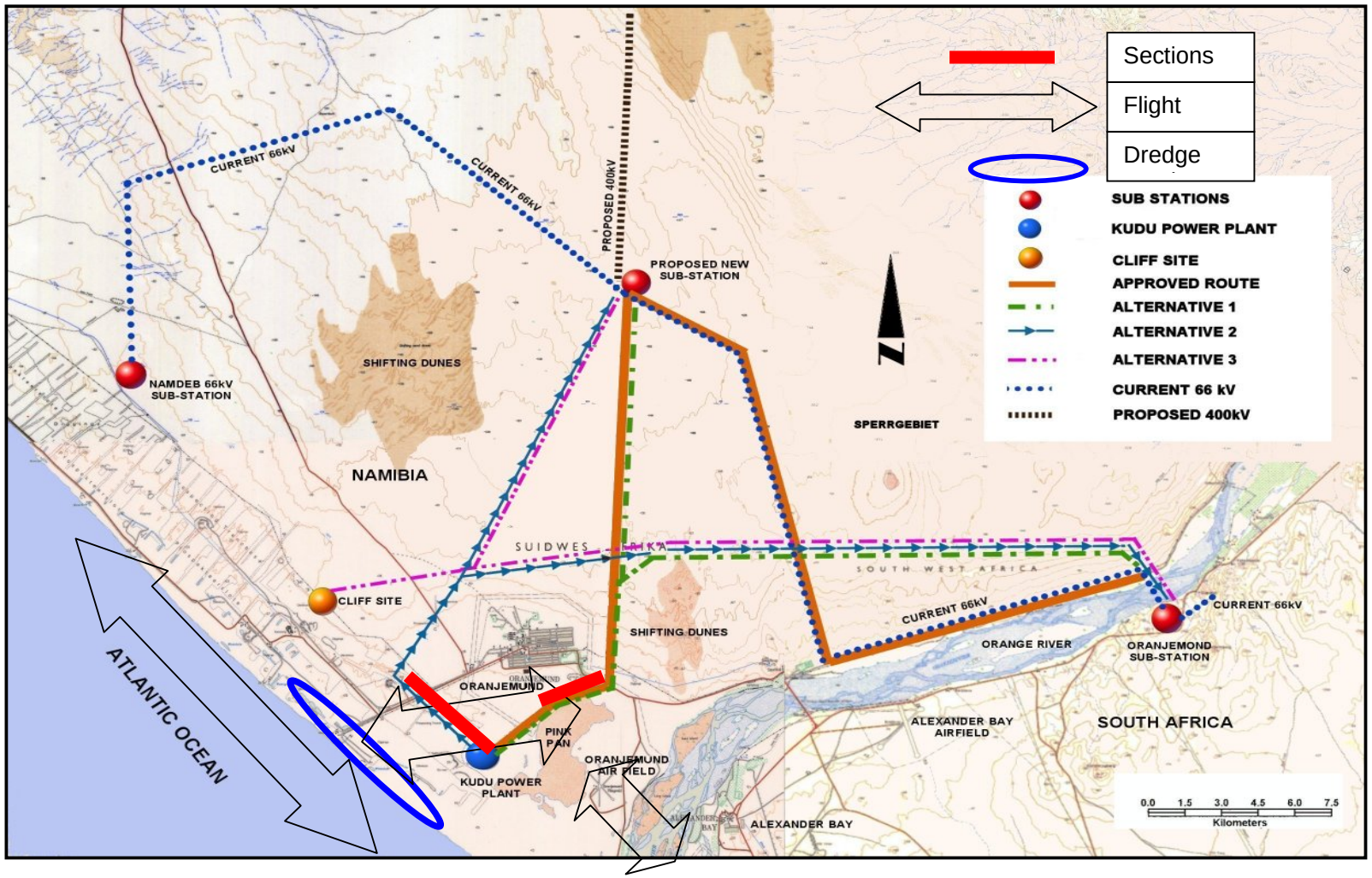
Van Rooyen, C.S., 2004b. Investigations into vulture electrocutions on the Edwardsdam-Mareetsane 88kV feeder, Unpublished Report, Endangered Wildlife Trust, Johannesburg, South Africa.

Van Rooyen, C.S., 2004c. Powerline Interaction Project: Progress Report: January - June 2004. Unpublished Report. Endangered Wildlife Trust, Johannesburg, South Africa.

Verdoorn, G.H., 1996. Mortality of Cape Griffons *Gyps coprotheres* and African Whitebacked Vultures *Pseudogyps africanus* on 88kV and 132kV powerlines in Western Transvaal, South Africa, and mitigation measures to prevent future problems. 2nd International Conference on Raptors: 2-5 October 1996. Urbino, Italy.

Williams, A. J. Velasquez, C., 1997. Greater Flamingo *Phoenicopterus rubber*. In: The atlas of southern African birds, Volume 1: Non-passerines, Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V & Brown, C.J. (eds). Bird Life South Africa, Johannesburg, pp112 - 113.

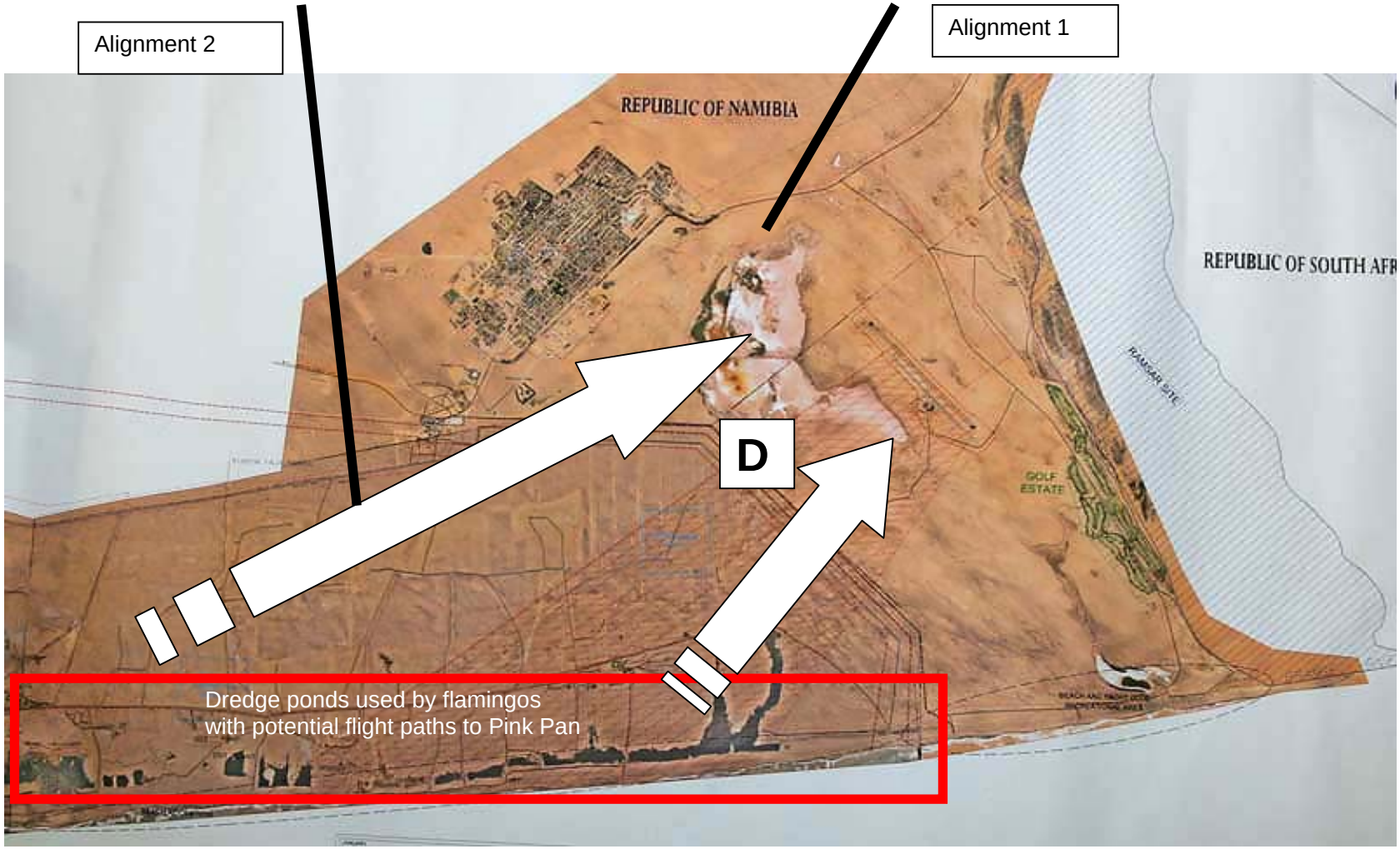
APPENDIX A MAP OF STUDY AREA



Appendix B Pink Pan																		
Waterbird surveys: Orange River: Pink Pan																		
Species	1-Jan-96	20-Apr-96	1-Feb-97	26-Jul-97	30-Jan-98	25-Jul-04	23-Jan-99	16-Jul-99	21-Jan-00	7-Jul-00	8-Feb-01	2-Aug-01	23-Jan-02	31-Jul-02	5-Feb-03	6-Aug-03	4-Feb-04	
		NB: these d																
Dabchick		1																
White Pelican		169																
Whtbrst Comorant		62																
Reed Comorant		1																
Grey Heron		1																
Blackheaded Heron	1						2											
Little Egret										1						1		
Cattle Egret				5						4						4		
Lesser Flamingo					4			128						49				
Egyptian Goose		2	10	2	3	2	20	2		8		2	3	2	2			
S African Shelduck	2	4	2	2	19	3			1	4	36	2	7		31	1	27	
Yellowbilled Duck		6		6		5	2	7		7		5		4	4		1	
African Black Duck																7		
Cape Teal	14	43	33	37	40	40		49		26	55	26	32	35	53	34	11	
Redbilled Teal							16											
Cape Shoveller						1	6	3		5	20		1		27			
Spurwinged Goose	1	8	2	4	15					1					1		3	
Mallard			1					2										
Afr Marsh Harrier										1								
Moorhen										1								
African Jacana		1																
Painted Snipe			2					2										
Ringed Plover	5	2	40		4				14		4		4		1			
Whitefronted Plover	1	8	6	8	12				4		6	3			3			
Chestnutbnd Plover	ot	12	6	32	7	52	5	54	22	59	16	23	27	21	2	4	2	
Kittlitz's Plover	8	61	9	56	10	35		78	13	50	20	13	6	21	2	2		
Threebanded Plover	1	29		20	1	25		42		17	3	3	11	11	1			
Grey Plover	1																	
Blacksmith Plover	9	17	13	7	8	11	10	18	1	9	10	8	14	13	28	7	24	
Wattled Plover				4														
Common Sandpiper			1															
Wood Sandpiper					1									3	1			
Marsh Sandpiper			2															
Greenshank								1			1				1			
Curlew Sandpiper	7		22	39		18	4	29	16	4	43		28	2	21	17		
Little Stint	49	3	44	1	1		6		40	6	197	31	77	3	5		2	
Sanderling			1															
Ruff	51		100		22				2		6		31		6		26	
Avocet	13	21	17	19	11	7	1	26		29	6	14	26	8	15	12	2	
Blackwinged Stilt				3		2	16	7		2		2		1				
Kelp Gull	13	21	54	90	56	5	4	344		164	70	290	3	21	3	241	5	
Hartlaub's Gull		8	2	14			2	5		1					2			
Caspian Tern		2																
Swift Tern										17				34				
Pied Kingfisher		3																
Cape Wagtail	6	24	4	26	14	15		25		6	5	2	6	5				
Unidentified Waders		27			40		24		19	8	7		6	11	3	1	2	
Total	182	536	371	375	268	221	118	822	132	430	505	424	282	244	212	331	105	
Unpublished data																		
Anderson, M.D. & Kolberg, H.																		

Appendix C: Bridge to Hohenfels													
Waterbird surveys: Orange River (bridge to Hohenfels)													
Species													
	4-Aug-04	5-Feb-04	8-Jul-03	4-Feb-03	31-Jul-02	22-Jan-02	1-Aug-01	8-Feb-01	5-Jul-00	20-Jan-00	15-Jul-99	24-Jul-98	30-Jan-98
Dabchick									1				
White Pelican													94
Whtbrst Comorant	84		82		2		49	28	3	3	2	10	
Reed Comorant		4				1	15		1		1	1	8
Darter	2		2	1	6	14	7	12	6	10	5	4	7
Grey Heron	1	3	4	2		15	2	1	5	1	1	1	6
Blackheaded Heron				1		1		1	6	1	1		
Goliath Heron		2			1	1							1
Purple Heron													
Little Egret	6	11	8	3	3	22	7	2		1		2	1
Cattle Egret	6		4	8	111	5	1	5			23		1
Blkcrn Night Heron					1	4		7		9	8	1	24
Hamerkop									1	2		1	2
Hadeda Ibis	5	2	6		1	8			5				4
African Spoonbill	4				5	26						5	5
Egyptian Goose	276	22	6	16	58	84	192	165	343	57	181	133	271
S African Shelduck	56	19	48		27		2	160	15		40	29	50
Yellowbilled Duck	5		2			25	6			8	7	4	3
African Black Duck												2	1
Cape Teal	1		27	1	46								
Redbilled Teal		11	2	3		5		39					6
Cape Shoveller					8								
Knobbilled Duck													1
Spurwinged Goose	27	4	28		28	1	77		105	23	9	96	24
Afr Fish Eagle	3	2	3			1	1	2		2			2
Afr Marsh Harrier	1												
Osprey		1		1		1							
Black Crake													
Purple Gallinule								1					
Redknobbed Coot												5	
Kittlitz's Plover	14	15	50	61	22	14	8				50	6	21
Threebanded Plover	3	10	19	15	8	2	3	3		2	3	2	4
Blacksmith Plover	5	10	13	51		41	26	26	29	40	26	15	
Common Sandpiper	2	5	2	4		4		3		2			4
Marsh Sandpiper										4			
Greenshank	4	12	2	11	5	17	2	5			1	1	4
Little Stint		47		19						53			
Avocet			20		16								
Blackwinged Stilt	2		1										
Kelp Gull	3	2	9	1	5	1	8	2			11	2	2
Hartlaub's Gull	1		2		8		2						
Caspian Tern	17	4	16		8	2	5				2		
Sandwich Tern		6											1
Common Tern		8		1									
Pied Kingfisher	21	10	7	7		26	8	12	11		1	6	5
Mlchite Kingfisher										1			
Afr Pied Wagtail	8	6	2	4	3	1	8	1	2	2	8	2	6
Cape Wagtail	14	47	95	38	27	24	36	9	12	12	15	23	41
Unidentified Waders	1					3							1
Fulvous Duck													
Total	572	263	460	248	399	349	465	484	545	233	395	351	600
Spp counted	26	24	26	20	22	26	21	20	15	19	20	22	28
Unpublished data													
Anderson, M.D. & Kolberg, H.													

APPENDIX D


Alignment 2
Alignment 1
REPUBLIC OF NAMIBIA
REPUBLIC OF SOUTH AFR
D
GOLF ESTATE
Dredge ponds used by flamingos
with potential flight paths to Pink Pan

APPENDIX E1 Impacts on Red Data waterbird species occurring in the ORMWP

Species	Nature of impact	Probability	Duration	Intensity	Extent	Significance	Status	Mitigation
Great White Pelican	Collisions with overhead shield wires at Pink Pan and Orange River crossing	Probable	Long term	Medium	Local	Medium	Negative	S
Cape Cormorant	None							
Sacred Ibis	None							
Glossy Ibis	None							
Hadeda Ibis	Collisions with overhead shield wires at Pink Pan and Orange River crossing	Probable	Long term	Medium	Local	Medium	Negative	S
Greater Flamingo	Collisions with overhead shield wires at Pink Pan	Probable	Long term	Medium	Local	Medium	Negative	L (no effective mitigation for collisions in misty conditions)
Lesser Flamingo	Collisions with overhead shield wires at Pink Pan	Probable	Long term	Medium	Local	Medium	Negative	L (no effective mitigation for collisions in misty conditions)

African Fish Eagle	Collisions with overhead shield wires at Orange River crossing	Probable	Long term	Medium	Local	Medium	Negative	S
African Marsh Harrier	None							
Chestnut-banded Plover	None							
Hartlaub's Gull	Collisions with overhead shield wires at Pink Pan and Orange River crossing	Improbable (but probable in misty conditions)	Long term	Medium	Local	Medium	Negative	S
Caspian Tern	Collisions with overhead shield wires Orange River crossing	Improbable	Long term	Medium	Local	Medium	Negative	S
Swift Tern	Collisions with overhead shield wires at Pink Pan	Improbable (but probable in misty conditions)	Long term	Medium	Local	Medium	Negative	S
Damara Tern	None							

Nature:	The type of effect that a proposed activity will have on the environment. A narrative of the impact.
Extent:	Geographic area. Whether the impact will be within a limited area (on site and immediate surroundings, LIM)), locally (within the powerline corridor; L), regionally (R), nationally (N) or internationally (I).
Duration:	Whether the impact will be temporary (during implementation only; T), short term (1-5 years; ST), medium term (5-10 years; MT), long term (longer than 10 years, but will cease after operation LT), permanent (P) or transient (TR).
Intensity:	Whether the impact is destructive or harmless. Low (L) where no environmental functions and processes are affected, Moderate (M) where the environment continues to function but in a modified manner or High (H) (environmental functions and processes are altered VH Environmental processes cease completely. May also be measured in accordance with acceptable standards, applicable conventions, best practice policy, levels of social acceptance, etc
Probability:	The probability that a certain impact will in fact realise; Uncertain (U), Improbable (I), Probable (P); Highly Probable (HP); Certain (C). If the probability is uncertain, then there is not sufficient information to determine its probability. Because the precautionary principle is followed, this increases the significance of the impact.
Mitigation:	The possibility to mitigate the impact. Completely (C), Satisfactory (S), Limited (L), None (N).
Status:	Negative, positive or neutral
Significance:	Low if the impact will not have an influence on the decision or require to be significantly accommodated in the project design, Moderate if the impact could have an influence on the environment which will require modification of the project design or alternative mitigation (the route can be used, but with deviations or mitigation) High where it could have a “no-go” implication regardless of any possible mitigation (an alternative route should be used).

Waterbird species		South Africa	Namibia	International
Great White Pelican	*Pelecanus onocrotalus*	Near-threatened	Endangered	-
Cape Cormorant	*Phalacrocorax capensis*	Near-threatened	-	Near-threatened
Sacred Ibis	*Threskiornis aethiopicus*	-	Vulnerable	-
Glossy Ibis	*Plegadis falcinellus*	-	Vulnerable	-
Hadeda Ibis	*Bostrychia hagedash*	-	Vulnerable	-
Greater Flamingo	*Phoenicopterus ruber*	Near-threatened	Endangered	-
Lesser Flamingo	*Phoenicopterus minor*	Near-threatened	Endangered	Near-threatened
African Fish Eagle	*Haliaetus vocifer*	-	Endangered	-
African Marsh Harrier	*Circus ranivorus*	Vulnerable	Vulnerable	-
Chestnut-banded Plover	*Chadadrius pallidus*	Near-threatened	Vulnerable	-
Hartlaub's Gull	*Larus hartalaubii*	-	Vulnerable	-
Caspian Tern	*Sterna caspia*	Near-threatened	Vulnerable	-
Swift Tern	*Sterna bergii*	-	Vulnerable	-
Damara Tern	*Sterna balaenarum*	Endangered	Endangered	Near-threatened

UPDATING OF AN ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN OF THE PROPOSED POWER LINES FROM THE KUDU GAS POWER STATION (UUBVLEI SITE) TO ORANJEMOND AND OBIB RESPECTIVELY

SPECIALIST CONSTRIBUTION:

Addendum to

BIRD IMPACT ASSESSMENT STUDY

APRIL 2005

Prepared by:

Chris van Rooyen
Endangered Wildlife Trust
Private Bag X11
Parkview
2122
Telephone: +27-11-4861102
Telefax: +27-11-4861506
Email: chrisv@ewt.org.za

Prepared for:

ENVIRO DYNAMICS
ENVIRONMENTAL MANAGEMENT CONSULTANTS

P O Box 20837
WINDHOEK
Namibia
Telephone: +264-61-223336
Telefax: +264-61-240309
E-mail: envirod@africaonline.com.na

TABLE OF CONTENTS

LIST OF FIGURES

1 BACKGROUND

In view of the need to ensure that the Kudu Gas Power Station project results in the lowest possible social, ecological and archaeological impacts, NamPower have considered a number of options for the siting of the power plant which, in turn, somewhat dictates the alignment of the power lines and the gas supply pipe line. The 1998 Preliminary EIA and the 2004 full EIA found site D to be acceptable technically and environmentally. However, NamPower has decided to also fully consider another site, namely Uubvlei, as a possible alternative site for various reasons, one of them being the potential for bird collisions on the approved alignment.

This addendum was requested from the environmental consultant, Enviro Dynamics, in order to assess the potential impacts on birdlife of the alternative powerline routes emanating from the new proposed Uubvlei site for the power station. This report should therefore be read in conjunction with two previous bird impact assessment reports compiled in August and November 2004, dealing with previous alignments. The information contained in those reports is still valid and only those aspects that are materially altered by the proposed new alignment will be discussed, as well as specific issues raised subsequently.

2 THE BRIEF

The brief from Enviro Dynamics was to do as follows:

- Assess the possibility of the new proposed powerline alignments crossing major bird flight paths.
- If so, what type of bird flight diverter should be used to mark the lines.
- Will crows nest in the transmission towers and if so, will it cause impacts on the quality of supply.

3 DISCUSSION

3.1 Flight paths

The major flight paths for birds around Oranjemund have been discussed in detail in the previous two reports. The new proposed alignments from Uubvley will most likely not cross any major flight paths (see white arrows on map below). Of particular importance is that the new alignments will not, as the previously approved alternative from site D, cross between the Pink Pan and the dredge ponds along the coast. This created the possibility of flamingo collisions as the birds move between the coast and the Pink Pan, especially during misty conditions when bird flight diverters are less effective.

The comments and recommendations with regard to the potential of collisions and disturbance of breeding birds at the Orange River crossing opposite Oranjemond substation on the South African border remains valid, as the new proposed alignments will still cross the river at exactly the same spot as the previously proposed alignments. However it has been

pointed out by Enviro Dynamics that the impact of the lines that cross the Orange River will be the responsibility of Eskom and not NamPower.

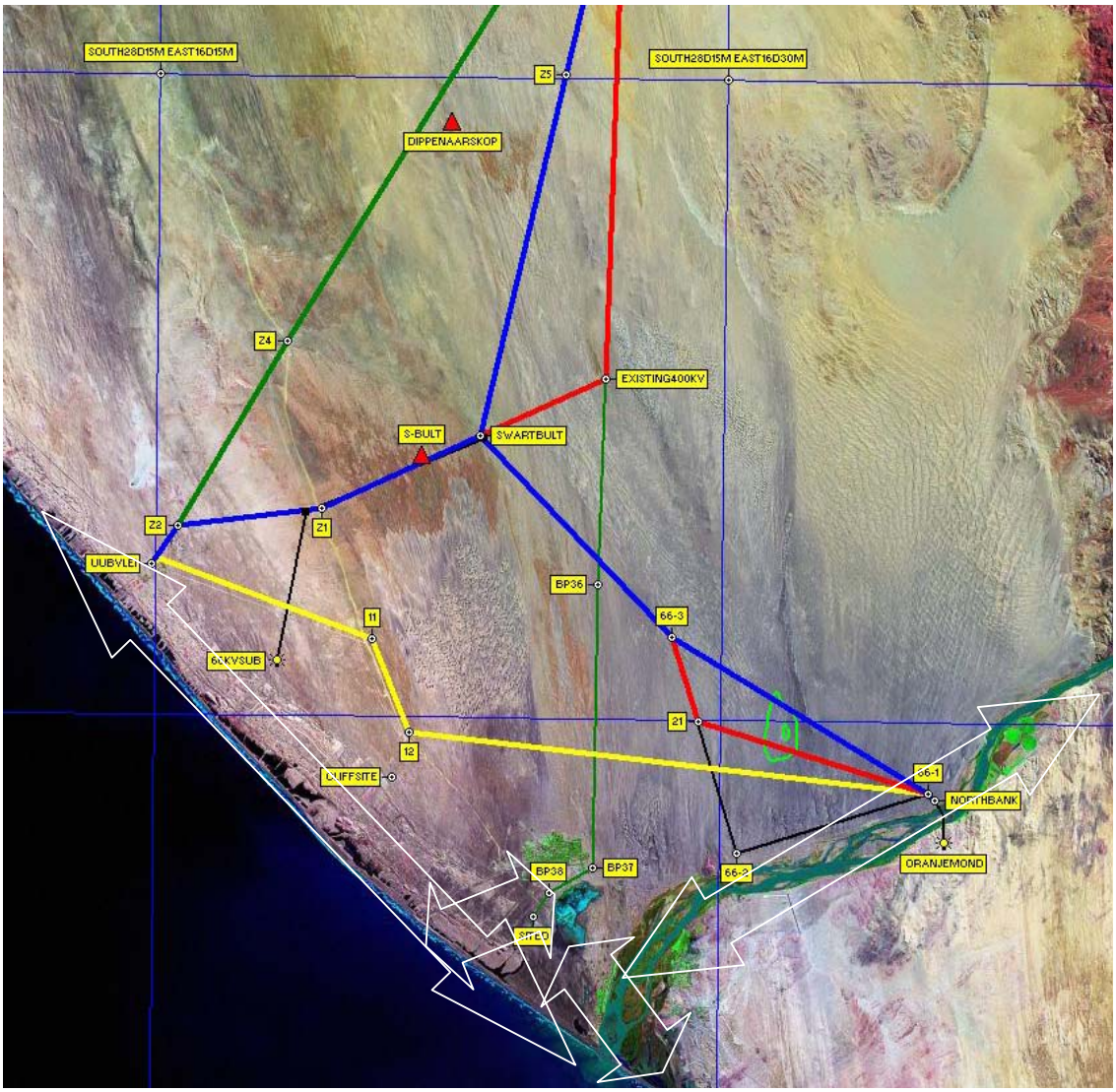


Figure 3-1: *Flight paths*

Bird Flight Diverters

As pointed out in previous reports, the lines that cross the Orange River will have to be marked with bird flight diverters. The products currently available in South Africa will soon be tested for mechanical durability as part of an Eskom research initiative, in order to arrive at a uniform set of criteria for bird flight diverters. Currently, the EBM Bird Flapper is used by Eskom Transmission.

Figure 3-2:

3.3 Crow nests

It is possible that Pied Crows might attempt to nest in the lattice work of the towers. The majority of the towers are cross-rope suspension types, which means the birds will nest away from the conductors in the two columns (provided enough support exists in the lattice work). This should not have any effect on the quality of supply.

Some of the towers will be self-supporting towers. In these instances the crows could potentially nest above the conductors, but this would again depend on whether the specific tower type that will be used will provide enough support for the crows to nest. In the event of a crow nesting directly above a conductor, there is the possibility that nesting material, specifically pieces of wire or plastic rope could cause a flashover across the air gap between the conductor and the intrusion, especially in wet conditions. It must be emphasised that this would be an uncommon event, although it has been recorded in South Africa. The crows themselves are too small to cause a problem with their streamers (excreta) on lines of this size. The best option would be to monitor the situation to see if any crows indeed nest in critical areas and then address the problem in an appropriate manner e.g. by blocking the nesting area and shifting the nest to a platform somewhere else on the tower.

Chris van Rooyen
Endangered Wildlife Trust

April 2005

APPENDIX 3

ARCHAEOLOGICAL ASSESSMENT

UPDATING OF AN ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN OF THE PROPOSED POWER LINES FROM THE KUDU GAS POWER STATION (UUBVLEI SITE) TO ORANJEMOND AND OBIB RESPECTIVELY

SPECIALIST CONSTRIBUTION:

ARCHAEOLOGY

Prepared by:

Dr. D. Noli

Prepared for:

ENVIRO DYNAMICS
ENVIRONMENTAL MANAGEMENT CONSULTANTS

P O Box 20837
WINDHOEK
Namibia
Telephone: +264-61-223336
Telefax: +264-61-240309
E-mail: envirod@africaonline.com.na

TABLE OF CONTENTS

LIST OF TABLES

1 INTRODUCTION

1.1 The region

The Sperrgebiet is a unique piece of access-controlled desert some 300 km long and 100 km wide, located in the south-western Namib. Most of it lies within the rough open rectangle formed by the Luedertiz-Aus road to the north, the Orange River to the south, and the Atlantic shoreline to the west. It was created in 1908 to protect the interests of the diamond mining industry, a purpose it serves to this day.

It is uncertain, however, how long the Sperrgebiet will continue to exist in its current form. Namdeb (Namibian De Beers), which once controlled the entire area, now only retains its coastal and riverside Exclusive Prospecting Licenses (EPLs), having recently handed the rest of what used to be the Diamond Area over to the Department of Environment and Tourism (DET). The interior part of the Sperrgebiet lying to the north of the road between Luederitz and Aus has been part of the Namib-Naukluft Park for several years. The access to the interior of the rest of the Sperrgebiet is currently controlled by Namdeb on behalf of DET. Numerous EPLs have, however, been granted to other companies to prospect in the all the areas of the Sperrgebiet that Namdeb has vacated. The entire Sperrgebiet is currently in the process of having its status changed to that of a National Park, and most of it will become a wilderness area.

1.2 The project

Nampower intends to erect and operate power lines in the southern Sperrgebiet. This is to form part of a grid which is to service a gas-fired power station which is to be constructed in the area to exploit the offshore Kudu Gas Field.

1.3 This study

The purpose of this study is to conduct the archaeological component of the full update of a Environmental Impact Assessment (EIA) which was originally done for the above-mentioned project in 1998/99.

1.4 The study area

The study area is located in the southern part of the Namibian Diamond area, or “Sperrgebiet”. Its southern border is formed by the Orange River, while the Atlantic lies to the west. The north and east is desert. The area it self is mainly made up of fixed dunes that are vegetated to various degrees, but also contains vegetation-free shifting dunes, river deposits, gravel plains, mountains and pans. It furthermore contains the town of Oranjemund, its access roads, its airport and its mines along the coast. No part of the research area is further than 90 km from the town of Oranjemund, the main area of interest running from Oranjemund in the south-west to the Scorpion zinc mine in the north-east.

2 METHODS

2.1 Literature review and map study

The study commenced with an in-depth review of all the published and unpublished literature relevant to the history and prehistory of the south-western Namib in general and the Sperrgebiet in particular, special attention being paid the study area. Following this, 1: 50 000 Trigonometric Survey maps and 1: 100 000 German maps from 1913 were used to make a detailed map study of the research area. The routes were then inspected on satellite images by means of a Geographical Information System (GIS) These exercises provided a rough idea of the kind of archaeological sites that could be expected to be in the study area, where they might be found and what kind of material they could contain. Where applicable, relevant modified and unmodified sections from previous reports by this author (e.g. Noli 1998) were included in this report.

2.2 Field trip

After the above preparations, a site visit was conducted, all the proposed routes being traversed by vehicle and inspected where necessary on foot for archaeological material.

2.3 Problems and Limitations

While the surface areas concerned have been inspected, subsurface sites will only be revealed during construction excavations. Several sites which had been located on earlier studies were, for instance found to be covered up by sand movement, whereas others previously hidden had been exposed. Also, while the exact proposed routes were inspected, the final routes which are selected might well deviate slightly from the proposed ones once all the relevant aspects of the terrain have been taken into consideration.

3 THE AFFECTED ARCHAEOLOGICAL ENVIRONMENT

3.1 Relevant background information

Davis and Walsh (1955) drew attention to the existence of ESA material in the diamondiferous raised beaches north of Oranjemund. Rudner and Grattan-Bellew (1964) reported ESA, MSA and LSA material from along the Sperrgebiet coastal region, and Rudner (1968) reported on pottery from the same area. Corvinus (1977, 1983) found ESA, MSA and LSA material between Arriesdrift and Obib on the northern banks of the Orange River, and ESA material on the raised beaches to the north of Oranjemund. Wendt (1972, 1975a, 1975b, 1976, 1978, 1980, 1981) conducted extensive research on the history, rock art, ESA, MSA and LSA of those parts of the south-western Namib lying outside the Sperrgebiet. Cruz-Uribe and Klein (1983) reported on some of the faunal remains of Wendt's excavations, as did Avery (1985). Noli (1989) investigated the archaeology of the Koichab River Area to the north of the road between Luederitz and Aus. Noli (1995) reported on an archaeological survey of the Sperrgebiet coastline and its boundary with the Orange River. Noli (1998) investigated the archaeology along the road from Luederitz to Oranjemund, Sendlingsdrift,

Rosh Pinah and Aus. The above sources, combined with personal observations, suggest the following scenario:

ESA artefacts such as hand-axes, cleavers, knives, scrapers, discoids, picks, spheriods, choppers, untrimmed flakes and cores made from river cobbles are found on the Proto/Meso-Orange deposits along the Orange River below Sendelingsdrif. These deposits are 50-80m high banks of sand, gavel and stones, which were deposited by the Orange River some 17 million years ago, after which the river cut through them, so that they now form bluffs overlooking the river. At one time similar artefacts made from beach cobbles were found on the raised beaches between Oranjemund and Affenruecken, but these sites have now been largely destroyed by mining activities. The ESA artefacts are from the Acheulian industry, indicating an age of between about one million and 200 000 years. Their distribution suggests that ESA people used the Orange River valley as a route to the coast, and ventured up the coast for some 70 km, but did not penetrate into the interior of the Namib desert. The amount of cores, flakes and half-finished tools, as well as numerous cores with pieces which can be re-fitted, indicate that the tools were manufactured along the Orange River. So far however, only one living site has been found, located some four km north of the Orange River at Obib. This raises the question as to where the other living sites are. As the mean sea level was lower during much of the ESA than it is today, many coastal ESA sites could have been drowned, while floods could have destroyed any ESA sites located in the sandy area right next to the river. Isolated ESA artefacts have been found away from the coast and from the Orange River, but these are of little significance, as they could easily have been brought in by MSA or LSA people as sources of raw material.

MSA artefacts in the form of blades, points, scrapers and flakes have been found within about 12 km of the Sperrgebiet coastline, mainly at vantage points such as the tops of hills, or at present or past water sources such as springs and dry pans in presently inhospitable areas. This suggests that conditions may have been slightly wetter than they are at present during at least some of the MSA period. MSA sites are rarely found closer to the coast itself than about 3 km, a phenomena that could be attributed to changes in sea level, which may have drowned most coastal MSA sites. As was the case with ESA artefacts, MSA artefacts also occur on the Proto/Meso-Orange River deposits along the Orange River below Sendelingsdrif, and may have occurred more numerously next to the river itself before floods destroyed them. In addition, MSA artefacts also occurred on vantage points along the river. Accounts of MSA material being found well away from both the coastline and the river are limited but convincing, and both open sites and rock shelters have been reported. The most spectacular rock shelter is the Apollo 11 site, excavated by Wendt, the evidence from which suggested an MSA occupation until about 25 000 years ago. This may clash slightly with the general view that the MSA lasted from about 200 000 years ago until about 40 000 years ago in southern Africa, but the exact time period of the MSA does vary a somewhat from site to site. In 1988 Mr. Daan Marais found a fossilized human skullcap near Oranjemund. Efforts are currently under way to determine its age, but it is thought to be from the MSA.

The LSA is generally believed to have lasted from about 40 000 years to ago to the present. In addition to stone tools such as flakes, cores, microliths (stone tools small enough to fit into a matchbox) and grindstones, it includes ostrich eggshell water containers, ostrich eggshell beads, seabird eggshell, seashells, bone, pottery, glass, metal, charcoal and wood. LSA sites are located along the actual coastline in the form of shell middens, and at water sources near the coast and along natural routes to the interior. It would therefore seem that, while LSA man inhabited the coast, the desert itself was merely travelled through. The lower Orange River, being both a water source and a natural route to the interior, is rich in LSA sites, which are concentrated in the sandy area lying between the river and the Proto/Meso-Orange deposits. The LSA inhabitants of the area, like the MSA people before them, made extensive use of open sites, but did not hesitate to use rock shelters when these were conveniently located. The coastal evidence suggests that sites with formal mircrolithic tools

may date to between 5600 and about 2400 years ago, whereas evidence from the interior suggests that microliths may have been introduced about 10 000 years ago. This is not necessarily a contradiction, since all coastal LSA sites much older than about 5000 years were in any event drowned by rising sea levels. Pottery is generally taken as having been introduced into southern Africa about 2000 years ago. With three exceptions, however, all dated sites with pottery in southern Namibia are from the last 500 years, so that pottery sites can generally taken as being both free of microliths and being only about 500 years old in the south-western Namib. Stone circles and graves, though rarely directly dated, are generally attributed to the LSA. LSA people probably only entered the Namib Desert after good rains, never permanently or even on a regular basis.

Both painted and engraved rock art exists in the area. A painted rock slab from the Apollo 11 cave has been reliably dated to 28 000 years, but the age of the rest of the art, as well as the identity of the authors, is still very much under discussion. According to Wendt (1978), however, the heavily patinated naturalistic engravings of both humans and animals should be attributed to "Bushmen", and may be about 6 000 or 8 000 years old. The abstract engravings should, on the other hand, he attributes the Nama of Bethanien, a scenario which would mean that they were only made during the last 500 years.

The end of the LSA coexisted with the beginning of historic times. It would seem that hunting and gathering Nama in possession of ceramics entered the southern Namib some 500 years ago, either displacing or absorbing the remnants of the original population. These Nama may have been the "Bushmen" referred to by the early travellers. Who the original inhabitants were is not known, but small groups of Damaras lived at least as far south as the 26th parallel prior to the 19th century. In the course of the 19th century both the "Bushmen" and the Damara were displaced, enslaved or exterminated by various waves of nomadic Nama herders, who had first crossed the Orange River from the south in the 17th century. The Nama herders were in turn subjugated by the German colonial forces, which were expelled by the South Africans during WWI. In 1931 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. The adults were variously charged with trespassing in the diamond area, having unlicensed dogs and weapons, and the possession of klipspringer and gemsbok skins and gemsbok meat, and were jailed for up to five months. Once their survival strategies had been curtailed, the Namib nomads ceased to exist.

The legacy left by the Namib nomads is not only made up of the archaeological record, but also of an intricate system of roads and tracks. The reason for this is that the first Germans used the last Bushmen as guides. As these Germans were either travelling on foot, or on horseback, or with ox wagons, they were very reliant on the ready availability of water en route. It follows that the Bushmen would have guided the colonials along the best routes with the best water sources. These routes, dutifully mapped by the Germans, eventually became paths, tracks and dirt roads, still leading past the water sources, which often became the locations of the farmhouses, or even of towns. Inside the Sperrgebiet, where many of the German tracks fell into disuse after WWI, and where the Bushmen no longer roam, the old routes have now completely disappeared. They can, however, still be followed by the simple expedient of using German maps pre-dating WWI, especially the 1:100 000 series prepared by Sprigade and Lotz (1913). These maps not only show the routes with great accuracy, but also indicate the waterholes. Along these routes and at the waterholes, German artefacts can be found, and archaeological sites abound.

The German and subsequent mining activities, which commenced in 1908 with the discovery of diamonds in the vicinity of Kolmanskop, have also left a substantial amount of traces in the Sperrgebiet. These, however, are mainly limited to a narrow coastal strip some 16 km wide, the most of the earlier activity having taken place between Luedertiz in the north and Bogenfels in the south. The remains are largely in the form of four major ghost towns

(Kolmanskop, Elisabeth Bay, Pomona, Bogenfels), ruined diamond plants, abandoned diamond workings, disused narrow gauge railway lines and derelict mining equipment. Due to the proximity of the sea, the moisture from the fogs and the strong winds that the coastal strip is known for, these historical remains are rapidly deteriorating. Some of the houses (one or two in each of the ghost towns) have been restored and are being maintained, but these represent the minority.

While the modern mining period – which started in the late 1920's with the discovery of diamonds in the vicinity of the Orange River mouth – was initially limited to the coastal strip between Chamais in the north and Oranjemund in the south, this is no longer the case. The modern plant at Elizabeth Bay, the pocket beaches, the workings along the Orange River itself and the efforts of land and sea-based subcontractors have ensured that the entire coastline of the Sperrgebiet, as well as the adjacent banks of the Orange river, are being subjected to extensive mining and prospecting activities.

3.2. Buried sites

While it could be argued that archaeological sites are clearly recognisable, this is sadly not the case. The mining process is NOT geared to identify archaeological material. Late in 2002 an elephant tusk turned up on a conveyor belt in the mining area at Plant 3, near Oranjemund. No other elephant bones were found at the time. This means that, with the exception of that one tusk, an entire elephant was mined, loaded, transported to the crusher and processed unseen. The bones may well have been buried, but that is exactly the point: We don't know what is buried, and there is as yet no mechanism in place to find out. Corvenius(1983) spent a lot of her time picking over mine dumps for stone tools, and drew attention to the vast amount of buried archaeological material that exists in the mining area near the Orange River mouth. Hart and Halkett (1999) did an assessment of the archaeological baseline surveys that had been conducted by this author in the Sperrgebiet from 1995 to 1999, voicing their thoughts on the subject of buried sites as follows:

"Of particular concern are deeply buried archaeological sites relating to the Emian marine transgression of about 120 000 years ago. A site of this type (of which there are only a few in the world) was exposed at Boegoeberg south of Alexander Bay when a cave at the end of a buried gully was broken open to mine diamondiferous gravels. Unfortunately the bulk of the archaeological material was mined out of it before archaeologists had the opportunity to study the site in detail. This impact was unmitigatable and resulted in the loss of heritage of international importance… Potentially sensitive areas will need to be identified and monitored during mining operations. Identified sites need to be conserved or mitigated."

It follows that the occurrence of buried archaeological sites at ANY part of the Sperrgebiet coastline cannot be ruled out.

3.2 The latest research developments

The latest archaeological research developments in the Sperrgebiet (Noli 2003) made the suggestion that the prehistoric inhabitants of the area may have exploited the land snail Trigonephrus. While a previous report (Noli 1998) had made the connection between the land snail and archaeological sites in deflation hollows, it had been thought that the snails had been there because of the deflation hollows, not because of the archaeological sites.

The discovery, however, of a snail shell midden in front of a cave at Buntfeldschuh, demonstrated that their occurrence was the function of people, rather than of nature. This led to the investigation of several concentrations of land snail shells in the GP pan area, on a high dune ridge adjacent to the northern shore of the lower Orange River, near Oranjemund, all of which turned out to be archaeological sites associated with either LSA or MSA material. This came as quite a surprise, since the ridge is very exposed to the prevailing winds. A perusal of the relevant literature (Pallet 1995), however, revealed that the snails, while living on sand sheets and low dunes, are only active at night or in the early morning in the winter, during rain or heavy fog, when the surrounding desert is moist.

It follows that, in order to harvest the snails, prehistoric man would have to have been waiting for them first thing in the morning in their preferred habitat, on the natural dew trap formed by the exposed dune ridge. Thus, while things may have been cosier for man in the brushwood along the river, the snails were on the ridge, so that was where man had to overnight if he wanted to exploit them early in the morning.

It was furthermore noticed that three of the archaeological sites associated with snail shells were also associated with what appeared to be remains of bushman's candle wax that had been molten in a fire. Since bushman's candles occur on the same dune ridge, the possibility exists that they were used to cook the snails. Certainly, since the snail shells are not broken, it is only by cooking the snails or by placing them next to a fire to kill them that it would have been possible to extract them from their shells. Experiments with live snails will, however, have to be conducted to see how exactly they react to being subjected to heat. The occurrence of fossils of the snails in association with subsurface. Acheulian artefacts in MA 1 (Corvinus 1983) suggests that the they may have been utilised by ESA people as well.

The implications of this research means that archaeological sites can now easily be identified at a distance by means of their snail content. This method has only recently revealed that the sandy wastes of the interior of the Sperrgebiet – once thought to be comparatively barren with respect to cultural material – may actually be rich in archaeological sites.

3.3 Sites located during this study

A total of 21 archaeological sites were discovered during this study. They are listed below in Table 1. Also listed are 13 sites located in the area in 2004 (Table 2) , and 16 sites located in the area in 2002 (Table 3) and 16 sites located in the general area in 1995 (Table 4.)

The two disturbed sites (sites 1,2) are in any event of limited value. In addition, eleven of the other sites are a types so plentiful in the area that they do not warrant protection (sites 5,7, 9, 10 12,13, 15, 16, 18, 19, 20). Four of the sites (sites 3, 8, 11, 17), though important, are so extensive that they do not need protection either.

The four remaining sites, however (sites 4, 6, 14 and 21), are so important that they should either be excavated and removed entirely, or should preferably be fenced, signposted and

left untouched. The latter strategy has worked extremely well for Namdeb along the Orange River. And besides: Fencing in a site is MUCH cheaper than excavating it.

Of these important sites, site 4 is a highly unusual collection of three obviously man-made heaps of snail shell, indicating intense land snail exploitation at that point. Site 6 is a veritable midden of ostrich eggshell, mixed with other artefacts, showing that ostrich eggs were extensively utilised at this point. Site 14 is enigmatic for its grindstone with the three unique and completely inexplicable holes drilled in it, whereas site 21 is important both for the high quality of pottery it contains and for the fact that it contains sea shells. The first fact dates the site to the last 2000 years, whereas the latter shows that the people concerned, who lived 70 km from the sea, had some sort of direct or indirect contact to the coast.

Of the 21 sites, only four (sites 3, 6, 15 ,16 20) were not directly associated with snails. At this stage the use of land snails by early man is poorly understood and under researched, so that every little bit of evidence can potentially help, even if some of the sites concerned are not very extensive. Apart from the contents of the sites, their patterns and spatial distribution is of interest as well. Even so, it would appear that they may be much more plentiful and widespread than was previously suspected. While the area was traversed, many concentrations of snail shell – some with, some without ostrich eggshell fragments – were observed. These may well have been archaeological sites as well, but could not be identified as such because of the lack of obvious man-made evidence. The reason for this is that we do not as yet know enough about the habits of the snail itself. We therefore do not know if the snails themselves occur in dense “patches” which resulted in snail shell concentrations, or whether he snails occur spread out, their shells having been carried gathering points of early man, resulting in snail shell concentrations.

3.4 Abbreviations used

ESA:	Early Stone Age
MSA:	Middle Stone Age
LSA:	Late Stone Age
Hist:	Historic
CCS:	Crypto-Crystilline Silicate
OES:	Ostrich Eggshell
OES+beads:	Ostrich Eggshell And Ostrich Eggshell Beads
Snails:	Landsnail (Trigonephrus) Shell
GS:	Grindstone
BP:	Bend Point

Table 1: List of archaeological sites (XX) along proposed route options for the construction of power lines in the southern Sperrgebiet.

Located in 2005

Site No	Deg Min S	Deg Min E	General location	Type & comments
1	28 24.333	16 24.494	NW of BP 66-3	Disturbed LSA site on existing power line track. OES, Snails, one upper GS, one flake on quartrzite. Limited value – no need for protection
2	28 23.895	16 24.008	NW of BP 66-3	Disturbed site on existing power line track. OES, Snails, one upper GS cobble and three limpet fragments. Limited value – no need for protection.
3	28 29.914	16 32.202	SE of BP 66-3	Extensive MSA/fossil site complete with fossil OES fragments. Also, flakes and blade on quartzite. Limited value due to extent – no need for protection, but sample collection advisable.
4	28 30.620	16 31.509	SE of BP 21	Three snail middens/heaps, one with three MSA quartzite flakes on it. Extremely valuable – should be fence in, signposted, and protected at all costs.
5	28 30.884	16 32.648	SE of BP 21	MSA (?) site in hollow with OES, snails, quartzite "knife", large quartzite flake and two upper GS/hammer stones. Limited value – no need for protection.
6	28 30.925	16 32.852	SE of BP 21	LSA OES midden with burnt OES, quartzite cobble, quartzite upper GS, tortoise bone, burnt tortoise bone, snails, bird bone. Extremely valuable – should be fenced in, signposted, and protected at all costs.
7	28 30.958	16 32.996	SE of BP 21	LSA snail scatter with OES, quartzite flakes, quartzite chunk, broken quartzite hammer stone. Limited value – no need for protection.
8	28 31.100	16 33.455	SE of BP 21	Extensive, spread –out LSA snail scatter at high terrain point, near beacon. With silcrete core, quartzite chunks/flakes/ cobbles/cores, quartz hammer-stone, small quartzite "knife", one limpet, old glass (half a bottle), OES, one bone splinter, seal skull. Limited value due to extent, but sample collection advisable.
9	28 23.872	16 22.514	SW of BP Swartbult	LSA (?) Snail/OES scatter in sandy hollow with burnt OES. Limited value – no need for protection.

10	28 23.269	16 23.582	N of BP Swartbult	LSA Snail scatter in sandy hollows, with OES, burnt OES, quartzite upper GS, CCS flake. Limited value – no need for protection.
11	28 14.922	16 25.703	N of BP Swartbult	MSA site on top of fossil OES site, with snails, quartz flake and blade. The fossil site is extensive, running at least both 2km to the sout-east and 2 km to the north-west. Limited value due to its extent, but sample collection advisable.
12	28 13.908	16 25.972	N of BP Swartbult	MSA site in flat, open sandy area, with snails, OES and quartz flakes/blades. Limited value – no need for protection
13	28 11.657	16 26.538	N of BP Swartbult	LSA site on dune sand with snails, OES, lower GS, stone "hearth" and OES frag with hole bored through it. Limited value, but sample collection advisable.
14	28 11.630	16 26.565	N of BP Swartbult	LSA site (adjacent to and north of site 13) with snails, OES, three large lower GS and one large upper GS in quartzite with three holes drilled in the one end. Extremely valuable due to uniqueness of drilled GS. Should be fenced in and protected. Alternatively fully investigated and collected.
15	24 04.418	16 26.565	N of BP Z3	MSA site in large deflated open "pan-like" area in gravel, with CCS/quartz chunks/flakes. Limited value – no need for protection.
16	28 03.378	16 29.291	N of BP Z3	MSA/ESA (?) quartz flaking site with hammer stone, chunks and flakes. Limited value – no protection necessary
17	27 58.831	16.321 28	NE of BP Z6	Massive MSA/fossil site, appearing to extend east and west for a total of at least 4 km. Contains quartz MSA blades, fossil OES and fossil snail. Of limited value due to extent, but sample collection advisable.
18	27 55.976	16 29.917	NE of BP Z6	LSA snail site on red sand, with OES, quartz/CCS flakes as well as two lower GS. Two stone "hearths" some 30 m to NE Limited value, but sample collection advisable.
19	27 54.031	16 31.015	NE of BP Z6	Massive LSA (?) snail site on dune, with a bit of OES and one palm-sized CCS flake with secondary retouch. Limited value – no need for protection.
20	27 52.262	16 33.224	NE of BP Z7	Spread-out MSA (?) site with quartz chunks/cores, crystal quartz chunks/blade, snails, OES and a quartzite anvil and lower GS. Limited value – no need for protection.
21	27 52.747	16 32.171	NE of BP Z7	LSA site with snails, OES, burnt OES, pottery (rims and a handle), two limpet shells. Extremely

				valuable – should be fenced in, signposted and protected.

Table 2: List of archaeological sites (13) along earlier route options proposed in 2004 for the construction of power lines in the vicinity of Oranjemund.

Located in 2004

Site No	Deg Min S	Deg Min E	General location	Type & comments
1	28 33.497	16 26.808	N of BP 37	Disturbed ESA open site on old river deposit. Standard for Orange river. Two large ESA flakes and one ESA knife, all of quartzite river cobbles. Limited value- no need for protection, but sample collection advisable.
2	28 33.157	16 26.742	N of BP 37	Disturbed ESA open site on old river deposit. Continuation of previous site, with river deposit coming through the sand cover in various places. Quartzite LSA core on river cobble. Limited value – no need for protection, but sample collection advisable.
3	28 32.515	16 28.675	SW of BP 7	Disturbed MSA/LSA open site, two flakes, one each on quartz and silcrete. Limited value – no need for protection.
4	28 31.518	16 31.462	E of BP 2 / power line intersection	LSA open site snail scatter with one chunk CCS and one very weathered quartzite flake. Valuable, should be protected.
5	28 31.458	16 31.763	E of BP 2 / power line intersection	LSA open site with a snail shell midden with OES, three quartzite chunks, two LSA scrapers on CCS pebbles and one LSA flake on CCS. Valuable, should be protected.
6	28 31.394	16 32.652	E of BP 2 / power line intersection	LSA open site with a snail shell midden, pottery, quartzite upper grindstone, a lower grindstone-sized stone anvil on dolorite and several quartzite chunks. Valuable, should be protected.
7	28 31.345	16 33.310	E of BP 2 / power line intersection	LSA open site with a snail shell midden, OES and an upper grindstone. Valuable, should be protected.
8	28 31.380	16 33.472	E of BP 2 / power line intersection	LSA open site with a snail shell midden and an upper grindstone. Valuable, should be protected.
9	28 31.345	16 33.550	E of BP 2 / power line intersection	LSA /historic open site with a snail shell midden with iron, tin can, glass bottle fragments, a glass stopper, a brass flint striking fire lighter tube, complete with iron ring and “flint” striker, a scraper made on a quartzite upper grindstone,

				OES, quartz chunk, river pebbles. Extremely valuable, should be protected.
10	28 31.278	16 34.618	E of BP 2 / power line intersection	LSA open site with snail shell midden with one quartzite upper grindstone/ hammerstone. Valuable, should be protected.
11	28 31.248	16 35.083	E of BP 2 / power line intersection	LSA/historic open site with a few a snail shells and an intact bottle from German times. Valuable, should be protected.
12	28 31.325	16 35.618	E of BP 2 / power line intersection	LSA open site with a snail shell midden and a quartzite core with a refittable flake. Valuable, should be protected.
13	28	16	N of BP 1	A disturbed LSA open site with a snail shell midden, a quartz upper grindstone/ hammerstone and a quartzite flake. Limited value, no need for protection.

Table 3: List of archaeological sites (16) in the Namdeb Production Expansion Study areas near Oranjemund.

Located in 2002

Site No	Deg Min S	Deg Min E	General location	Type & comments
1	28 30.510	16 31.656	GP Pan	MSA(?) At GP Pan: Land snail concentration, one quartz, one quartzite flake, some chunks.
2	28 30.224	16 31.623	GP Pan	MSA. A few quartz/CCS flakes, plus a quartzite (MSA) blade. Site extends south.
3	28 30.434	16 32.290	GP Pan	MSA. Snail midden, plus OES frags, quartzite hammer stone, badly worn quartzite "MSA" flakes.
4	28 30.060	16 32.240	GP Pan	ESA/MSA/LSA & snail open site. Quartzite/quartz/CCS flakes, CCS MSA blade, ESA heavy-edged pieces, LSA flakes. Located on solidified dune, overlooking pan.
5	28 29.867	16 32.059	GP Pan	LSA(?) Snail midden with limpets and a lower grindstone in it.
6	28 29.790	16 31.819	GP Pan	MSA. Snail midden with a bit of OES and some broken MSA frags, including a (reutilized?) side-scraper.
7	28 30.071	16 32.380	GP Pan	MSA. MSA blade & fossil OES fragment in sort of deflation hollow on top of fossil dune ridge overlooking E side of GP Pan. The ridge seems to be lightly scattered with various concentrations of quartzite MSA flakes.
8	28 32.834	16 28.222	GP Pan	ESA/MSA. (previously reported). A dune site in

				a massive hollow on the S side of a set of very large dunes: Snails, lots of OES, also ESA knife, MSA flakes in quartz, quartzite, CCS. MSA blades & points, quartzite cores, hammer stones, small handaxe.
9	28 33.097	16 28.321	GP Pan	LSA. Badly eroded pottery and some OES fragments on dune slope above a large hollow to E of P92.
10	28 28.770	16 38.056	GP Pan	LSA. On dune ridge to W of Skilpad: Very large, spread-out and thinly scattered open LANDSNAIL site, several 100 m in all directions. OES, burnt OES, snails, quartz/quartzite/CCS flakes, quartzite core, plus an A1 PERFECT OES water bottle. Also pottery, quartz chunks, OES bead (10 mm).
11	28 28.092	16 39.609	GP Pan	LSA. (previously reported). Site where some 2 dozen OES water bottles had been exposed on a dune, and left in situ. Site (originally located with trimble "banana" GPS) actually 100 m out. Site now completely destroyed, only OES frags remain. Combination of wind blowing eggs against each other and Gemsbok stepping on them. Guess they should all have been removed at the time, since the site was too exposed to guarantee their safety.
12	28 28.236	16 38.715	GP Pan	LSA(?) Another snail site next to Rd – goes on for hundreds of m in all directions: OES, snails, pottery, two limpets, CCS/quartz/ quartzite flakes (some of them large), quartzite blade, hammer stones. NNB: in the same area as snails: Concentrated "melted" Bushman Candle wax, fire-blackened. So Bushman candles were used for fuel!
13	28 28.139	16 38.976	GP Pan	ESA/LSA. A mini-handaxe, located on a snail/OES/pottery site.
14	28 28.242	16 37.983	GP Pan	LSA. Another large snail site, with CCS/ quartzite/quartz flakes, quartzite hammer stone, OES, snails, melted Bushman's candles.
15	28 28.602	16 36.812	GP Pan	ESA/MSA. Another snail site: Snails, OES, melted Bushman's candle, hammer stones, quartzite blades/flakes, ESA handaxe.
16	28 28.343	16 38.774	GP Pan	LSA. Bushman's candle "circle, with base of 4m x 5 m, 0.3 m high. Also some bone fragments on the circle, CCS flakes and OES fragments nearby.

Table 4: List of archaeological sites (16) along the southern margin of the Sperrgebiet, from Hohenfels in the east to the Orange River Mouth in the west.

Located in 1995.

Site No	Deg Min S	Deg Min E	General location	Type & comments
1	28 31.222	16 36.104	Hohenfels/Swartkop	LSA open site
2	28 31.952	16 35.722	Hohenfels/Swartkop	LSA open site
3	28 32.069	16 35.524	Hohenfels/Swartkop	LSA open site
4	28 32.112	16 35.401	Hohenfels/Swartkop	LSA open site
5	28 32.131	16 35.200	Hohenfels/Swartkop	LSA open site, (?) grave
6	28 32.137	16 35.078	Hohenfels/Swartkop	LSA open site
7	28 32.168	16 35.013	Hohenfels/Swartkop	LSA open site
8	28 32.216	16 34.883	Hohenfels/Swartkop	LSA open site
9	28 32.368	16 34.291	Hohenfels/Swartkop	LSA open site
10	28 32.571	16 33.767	Hohenfels/Swartkop	ESA/MSA/historic open site
11	28 32.547	16 33.551	Hohenfels/Swartkop	ESA/MSA open site/ 2 graves
12	28 32.708	16 33.230	Hohenfels/Swartkop	Grave
13	28 32.765	16 33.023	Hohenfels/Swartkop	LSA open site
14	28 32.901	16 28.233	Oranjemund	ESA/MSA/open site
15	28 36.179	16 27.173	Oranjemund	Historic open site
16	28 33.510	16 27.105	Oranjemund	MSA open site

3.5 Sensitivity to disturbance

Archaeology is the reconstruction of the past based on the physical remains of that past. It follows that the mechanics of archaeology are very similar to detective work. The only difference is that, unlike Sherlock Holms, who inspects the room the morning after the murder, the archaeologist inspects the rock shelter thousands of years after the event, carefully sifting through rubble and refuse.

For this reason the slightest disturbance at an archaeological site amounts to tampering with the already very sketchy evidence, thus making the task of the archaeologist difficult, if not impossible. It cannot be stressed enough that not only the physical integrity of the material evidence – for instance a stone tool such as a hand axe – is important but also the context in which it has been found.

Archaeological sites from any given time period are finite and do not seed or regenerate in any way. It follows that they cannot be rehabilitated. This makes them highly sensitive to any form of disturbance.

4 IMPACT OF CONSTRUCTION

This impact of the construction, operation, maintenance and decommission of the power line in the southern Sperrgebiet is discussed and assessed below and is summarised in Table 4.

4.1 Sources of risk

The entire process of construction, operation maintenance and decommission of the power lines and construction camps would put the archaeological record at risk.

4.2 Impact identification

The impact concerned would be in the form of considerable surface and subsurface disturbance, which would either physically destroy the archaeological evidence or remove it from its original context, thus robbing it of its scientific value.

4.3 Assessment

The impact would be specific, permanent, all-encompassing, and unavoidable.

Table 5: Impact along the proposed power line routes

Criteria for assessing impacts:

Nature of impact:	The actual processes of construction, operation and decommission of the line – to the extent that they cause surface or subsurface disturbances – may either destroy or disturb archaeological material.
Extent:	Specific, provided all activities are limited to the construction corridors
Duration:	Permanent, as archaeological material and its context are irreplaceable.
Intensity:	High, as the construction process will largely annihilate all archaeological evidence it encounters.
Probability:	Definite, the impact from the construction process is guaranteed to take place.
Status:	Negative, since a healthy environment should retain its archaeological evidence.
Significance:	Medium, due to the fact most of the archaeological material which will be encountered occurs elsewhere as well.
Degree of Confidence:	High, since there are archaeological sites located directly in the path of some of the power line route options, and since other archaeological sites are known to occur in the general area.
Mitigation:	Restricting access to the construction corridors, demanding a hefty monetary deposit against non-compliance and closely monitoring the construction process to ensure compliance with the EMP.

5 RECOMMENDATIONS FOR MITIGATING MEASURES AND MONITORING

5.1 Route selection

The route selection has been previously discussed elsewhere (see Appendix A), complete with all the relevant GPS points and other than archaeological considerations, such as technical and aesthetic ones. Various recommendations and suggestions were made, but it is not as yet know whether or not they will be approved. Similarly, while the general routes may have been selected, the terrain is vast and unexplored, and has yet to be evaluated from and engineering and construction point of view. Even so, the archaeology of the area would appear to be such that small changes in the exact location of the power lines will in all likelihood not encounter fatal archaeological flaws. Here it has to be considered that large sites can "take the punch" of a power line due to the size of the witness section that remains by default, whereas small sites can either be avoided, lifted, or fenced off. If the worst comes to the worst, the service road could go around important sites like sites No. 21, while the wires actually pass *overhead.*

At the time of the previous discussion (Appendix A) there was some concern about the three fossil sites which the power line had encountered. After these sites had been discussed with R. Spaggiari, the Namdeb Exploration manager, who has extensive experience of the fossil sites of the southern Sperrgebiet, it was concluded that – in spite of being of considerable scientific interest, these sites were of such a nature both as far as extent and content were concerned that they could indeed be crossed by the power line, provided that collateral damage was limited to the construction corridor.

And additional problem did however arise: On the section from BP 66-1 to 66-3, the direct (blue) route had been discarded in favour of the indirect (red) one, the motivation having been the impression of the indirect route being less of a threat to both the intervening fossil site and the Namdeb ore reserves. Discussions with R. Spaggiari, however, revealed that not only the red and the blue options, but also the yellow are far too close to the Namdeb ore reserve for comfort. It was therefore suggested that a new bend point be put in north of the blue route, at a point located at roughly at: S 28 29.239, E 16 32.368, which lies some 1500 m to the north of the point where the blue route intersects both the fossil site and the parallel of 28 deg. 30 min.

It follows that neither this new option, nor the route options which were proposed after the last field trip have as yet been investigated in detail on the ground, and neither have the route options which actually fall within the coastal mining area. Time constraints prevent these routes being investigated at the present. Where possible, they will be dealt with at a later stage in the form of addenda. It is not expected, however, that such investigations would drastically alter the picture.

5.2 Ensuring compliance

It is completely useless to have specialist studies done, to conduct EIAs, to design Environmental Management Plans (EMPs) and to then go ahead with complete disregard for the stipulations of the EMP. Rules are a farce if there is no compliance.

It follows that there must be constant monitoring of the construction process by an INDEPENDENT environmental co-ordinator. There must be zero tolerance for non-

compliance by all contractors and sub-contractors. There must be prohibitively expensive and immediate fines (to be deducted right away from a deposit amounting to at least 10% of the value of the contract concerned) for even the slightest transgression with respect to the EMP. This must be combined with the IMMEDIATE cessation of all construction activities until the concerned transgression has been mitigated. Past experience has shown that the instant REALITY of idle equipment and personnel, combined with the loss of a prepaid deposit and the impending and unavoidable activation of late delivery clauses, is far more effective at ensuring EMP compliance than the POSSIBILITY of unspecified fines at some distant point in the future.

6 CONCLUSIONS AND RECOMMENDATIONS

From an archaeological point of view, there are no fatal flaws in the proposed routes that have been investigated, provided that the four sites, which have been designated as important are duly fenced off and avoided during the construction process.

It is recommended that full compliance with respect to the final EMP be enforced by means of a pre-paid deposit, zero-tolerance monitoring and stringent penalty clauses. In order to avoid a rubber-stamping operation, the monitoring must be done by an entity or person appointed at the sole discretion of the Chief Warden of the National Park in which the development will be taking place.

7 APPENDIX A

7.1 GENERAL OVERVIEW OF POWERLINE ROUTES, by Dr. D. Noli 3/4/2005

Note: All GPS points are given in S deg, min – E deg, min. Grid references are provided for the first mention of all waypoints in the body of the text. GPS points provided by this author have a "Z" prefix. Three decimal points are provided for minutes, in order to avoid the confusion of two decimal points with seconds.

a) Northbank to Swartbult

From **Northbank** (28 31.810 – 16 35.690) to **66-1** (28 31.670 – 16 35.520), both the red and the blue options run together. The way **66-1** is currently positioned leads to the approaches to it from the west traversing a somewhat steep and sandy slope, which could cause construction problems or problems for maintenance vehicles trying to follow the line to the west. Moving **66-1** slightly northwards and/or putting in an additional bend point may alleviate this problem. The power lines will only be accessed from either end, so the ends must be drivable from both directions.

From **66-1** there are two options to reach **66-3** (28 28.050 – 16 28.690), where it joins up with the existing Namdeb line. The direct one (blue) and the indirect one (red) via point **21** (28 30.030 – 16 29.410) on the existing Namdeb line, which then follows that line to point **66-3**. The blue option, while shorter, traverses both the GP pan area (a Namdeb resource) and a fossil site adjacent to the east of the pan. The red option avoids both the fossil site and a much more of the Namdeb resource area. In addition, while it is longer, it traverses less pristine desert, since it links up earlier with the existing Namdeb line. With the exception of the traversing of the slope near **66-1**, neither option crosses physically challenging terrain.

From **66-3** to **Swartbult** (28 23.390 – 16 23.550) the route follows the existing Namdeb line and is entirely problem-free.

b) Swartbult to Uubvlei

From Swartbult the Route (blue) follows the existing Namdeb line to the west, intersecting the road to Luedertiz at point **Z1** (28 25.130 – 16 19.395). From **Z1** to **Z2** (28 25.579 – 16 15.596), a point just clear of the Uubvlei scrapyards, and on to **Uubvlei** (28 26.480 – 16 14.880) itself, the route is within the high security mining area, and has not yet been fully investigated on the ground.

c) Uubvlei to Schakalberg

There are two route options from **Uubvlei** to Schakalberg, the direct one (green) and the indirect one (blue) both run first to **Z2** and then from **Z2** to **Z3** (28 07.944 – 16 27.487), but the blue route goes to **Z3** via **Z1** and **Swartbult**.

From **Z2** the green option runs within the restricted mining area for some 10 km before it intersects the road to Luedertiz at point **Z4** (28 21.217 – 16 18.436). This section has not yet been fully investigated on the ground. From **Z4** to where it passes to the west of Dippenaarskop, the green route traverses some 15 km of very dense vegetated hummocks. These make for highly unpleasant driving, but could easily be neutralised by a bulldozer. Adjacent to Dippenaarskop there is a sandy traversing section, as well as a section with some comparatively steep stabilised dunes, both of which may present construction challenges and which had best be inspected by the construction engineer. Similarly, the last 8 km of this route section to **Z3** contains some stabilised dunes and one moving dune which may present possible construction challenges. It is suspected, however, that these challenges, while possibly leading to minor cost increases and/or line deviations do not represent fatal flaws.

The blue option, after traversing the already discussed section from **Uubvlei** to **Swartbult**, is extremely uneventful and very easily driven as far as **Z3**. The only possible problem occurs some 17 km north of **Swartbult**, at **Z5** (28 14.922 – 16 25.703) where the route crosses an extensive exposed fossil site that forms a mini-escarpment, extending (as inspected on foot by this author) at least 2 km to the west and to the east of **Z5**. If this route is chosen, and if the site is to be avoided, putting one extra bend point either 3 km to the West or 3 km to the East of **Z5** may not be advisable, as this may well put the route into some rough and high ground to the south-east of Dippenaarskop, or into some dunes to the south of **Z5**. A better avoidance move may be to put in three extra bend points, leaving the current route some 3 km to the south of **Z5**. Avoiding the site by passing it at a point either 3 km to the west or 3 km to the east of **Z5,** and then rejoining the current route again some 3 km to the north of **Z5**.

d) Schakalberg to Scorpion

The original blue route, running directly from **Z5** to the **Obib** (27 51.190 – 16 38.42) substation at the Scorpion mine, is not feasible due to joint obstacles of the Schakalberg and the northern section of the Obib Dunes. After the helicopter inspection was therefore

suggested to detour around the northern end of the Schakalberg, via bend points **Z6** (28 02.734 – 16 26.126, to the north-east of Schackalsberg), **Z7** (27 52.975 – 16 31.605, at the northern edge of the Obib dunebelt), and **Z8** (27 50.771 – 16 36.570, a neck in a rocky ridge near the **Obib** substation.

The first leg of this detour, from **Z3** to **Z6**, is some 10 km long. As it stands, however, it unfortunately does not run entirely in the bottom of the valley concerned, spending the last 2 km or so on the slopes of the Schackalsberg. In addition to that, **Z6** and **Z7** are located in such a manner that the route currently runs through a neck on high ground, rather than around the Schackalsberg. It is therefor proposed that **Z6** be relocated some 500 m to the west and some 1000 m to the north, to **Z6B** (28 02.214 – 16 25.819).

The second leg of the detour, from **Z6 to Z7**, is problematic for four reasons as it stands. Firstly, there is the already mentioned neck on high ground. Secondly, it intersects with a massive fossil site at **Z8** (27 58.831 – 16 28.321). Thirdly, it goes right over the crown of a rocky hillock at **Z9** (27 55.741 – 16 30.067). Fourthly, it encounters a moving dune of well over 6 m in height at **Z10** (27 53.601 – 16 31.253).

One option for tackling these problems would be to run the second leg from **Z6B** to **Z11** (27 53.194 – 16 31.062), a point obtained by extending the third leg westward by one kilometre. This would result in the neck being missed, only the western margin of the fossil site being disturbed, the rocky hillock being missed and the high dune being avoided. It has to be noted, however, that this modified leg has merely been inspected by means of GIS, and has not yet been driven on the ground. The western margin of the fossil site is adjacent to high and rough ground, and may well present construction challenges. Similarly the new section through the dunes may encounter other, even larger moving dunes. On the whole, however, some judicious juggling of the endpoints of the second leg will eventually make it feasible if one can (in the event of the western margin of the fossil site being too rough) live with the idea of crossing the fossil site.

The option of changing the second leg to avoid the fossil site by running it due east from the point where it intersects a line parallel to and 500 m to the north of the 28th parallel until it intersects an existing north/south track at **Z12** (27 59.756 – 16 32.123) and following this track north until it intersects with the existing second leg at **Z13** (27 54.650 – 16 30.669) was investigated on the ground. While perfectly feasible from a construction point of view, this option unfortunately runs on high ground along a very scenic route from **Z12** to **Z13**, making it unacceptable from an aesthetic point of view, since it would ruin the horizons of a massive area and seriously degrade the wilderness experience.

The third leg of the detour, running from either **Z7** or **Z11** to **Z8**, is unproblematic, even though it crosses a few rocky ridges on lower mountain slopes. This brings with it another observation: It has to be established how wide the final construction corridor for all the phases will be, and then it has to be decided whether the route is to go along the centre, the eastern side, or the western side of the route. Depending on where the dunes or the rocky ridges are, a second line built on the "wrong" side of the first line could well end up being cut off by a combination of the first line and the terrain. It follows that some additional bend points may be called for in the end. These would also enable the rocky ridges and the lower mountain slopes to be avoided.

The fourth leg of the detour, from **Z8** to **Z14** (27 50.798 – 16 38.227), the line exit point at the Obib substation, is not problematic either, but could not be followed all the way, since the would have meant exiting the Sperrgebiet, which would only have been possible via the gate at Sendelingsdrift.

e) General Comment

On the whole, it would appear that there are no fatal flaws in the route options as such as long as the general corridors are followed, and as long as every effort is made to keep off the horizons and the inselbergs, thus preserving the wilderness character of the area concerned. The various specialist reports, however, must still be taken into consideration, and the fossil sites must be more fully evaluated.

8 REFERENCES

AVERY, G. 1985. Late Holocene use of penguin skins: evidence from a coastal shell midden at Steenbras Bay, Luederitz Peninsula, South West Africa – Namibia, Ann. S. Afr. Mus. 96(3): 55-65.

CORVINUS, G. 1977. Palaeontological and archaeological investigations in the lower Orange Valley from Arrisdrift to Obib. Palaeocology of Africa and the Surrounding Islands 10/11: 75-91.

CORVINUS, G. 1983. The raised beaches of the west coast of South West Africa/Namibia: an interpretation of their archaeological and palaeontological data: Munich: C.H. Beck.

CRUZ-URIBE, K. and KLEIN, R.G. 1983. Faunal remains from some Middle and Later Stone Age archaeological sites in South West Africa. Journal SWA Wiss. Gesellschaft 37: 91-114.

DAVIS, O. and WALSH, R.C. 1955. Raised beaches and associated Stone Age material in Namaqualand. S. Afr. J. Sci. 51: 277-282.

HART, T. and HALCETT, D. 1999. An assessment of recent archaeological baseline surveys in the Sperrgebiet. Internal report prepared for NAMDEB by the Archaeology Contracts Office of the University of Cape Town.

HOFMANN, undated. 1:500 000 map of the Sperrgebiet, showing features, names and routes, believed to date from the 1930s. Original in Luederitz Museum.

NOLI, D. 1989. An archaeological investigation of the Koichab River region of the south-western Namib Desert, centred on the activities of Holocene hunter-gatherers. Unpublished M. A. Thesis, University of Cape Town.

NOLI, D. 1995. Reaching for the past. Ewi Namdeb 4th Quarter 1995: 16-21.

NOLI, D. 1998. Archaeological specialist study: Oranjemund Link Road EIA. Unpublished report, prepared for Enviroscience, Windhoek.

NOLI, D. 2003. Expansion sites archaeology: The archaeology of the land-based Namdeb Production Expansion Study (NPES) sites, conducted in the Sperrgebiet in October and November 2002. Unpublished internal report, prepared for Namdeb, Oranjemund.

PALLET, J. (ed.) 1995. The Sperrgebiet: Namibia's least known wilderness. DRFN and NAMDEB, Windhoek, Namibia.

RUDNER, J. 1968. Strandloper pottery from South and South West Africa. Ann. S. Afr. Mus. 49: 441-663

RUDNER, J. and GRATTAN-BELLEW, P. 1964. Archaeological sites along the southern coast of South West Africa. South African Journal of Science 60: 67-79.

SPRIGADE, P. and HEINE, F. 1911. Karte des Gebietes Laengs der Luederitzbahn zwischen Luederitzbuch und Schakalskuppe (1: 200 000), nach Aufnahmen des Regierungsgeologen Dr. Paul Range. Mitteilnungen aus den Deutschen Schutzgebieten 24.

SPRIGADE, P. and LOTZ, H. 1913. Karte des Sperrgebietes Deutsch Sudwest Afrikas in zehn Blaettern (1: 100 000). Berlin: Deutsche Diamantengesellschaft.

SPRIGADE, P. and MOISEL, M. 1904. Kriegskarte von Deutsch-Suedwestafrika
(1: 800 000) Berlin: Dietrich Reimer.

WENDT, W.E. 1972. Preliminary report on an archaeological research programme in South West Africa. Cimbebasia (B) 2: 1-61.

WENDT, W.E. 1975a. Ein Rekonstructionsversuch der Besiedlungsgeschichte des westlichen Gross-Namalandes seit dem 15. Jahrhundert. Journal SWA Wiss. Gesellschaft 29:23-56.

WENDT, W.E. 1975b. Hinweise auf das fruehere Vorkommen einiger Grosswildarten im westlichen Gross-Namaland.

WENDT, W.E. 1976. 'Art mobilier' from the Apollo 11 cave, South West Africa's oldest dated works of art. S. Afr. Archaeol. Bull. 31: 5-11

WENDT, W.E. 1978. Felsgravierungen im suedlichen Suedwestafrika. Journal SWA Wiss. Gesellschaft 32: 7-68.

WENDT, W.E. 1980. Fragmente aus der Ur- und Fruehgeschichte des westlichen Gross-Namalandes. Afrikanischer Heimatkalender (1980): 33-50

WENDT, W.E. 1981. Die Letzten Sammler und Jaeger aus der suedlichen Namib. Afrikanischer Heimatkalender (1981): 45-62

Werz, B.E.J.S. & Flemming, N.C., 2001. Discovery in Table Bay of the oldest handaxes yet found underwater demonstrates preservation of hominid artifacts on the continental shelf. South African Journal of Science 97, 183-185.

APPENDIX 4

BOTANICAL ASSESSMENT

UPDATING OF AN ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN OF THE PROPOSED POWER LINES FROM THE KUDU GAS POWER STATION (UUBVLEI SITE) TO ORANJEMOND AND OBIB RESPECTIVELY

SPECIALIST CONSTRIBUTION:

VEGETATION

Prepared by:

C.A. MANNHEIMER

Prepared for:

ENVIRO DYNAMICS
ENVIRONMENTAL MANAGEMENT CONSULTANTS

P O Box 20837
WINDHOEK
Namibia
Telephone: +264-61-223336
Telefax: +264-61-240309
E-mail: envirod@africaonline.com.na

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 TERMS OF REFERENCE AND OBJECTIVES

The consultant was requested to perform the botanical specialist contribution to the Environmental Impact Assessment and Environmental Management Plan for the proposed power line routes for the Kudu Combined Cycle Gas Turbine power plant between Uubvlei and Obib, by means of a field reconnaissance survey and review of other relevant information. The various route options (Figure 1) were to be considered regarding sensitivity to disturbance created by the proposed power lines, including both direct and indirect impacts during construction and operation.

The main objectives of the study were:

Assessment of perturbations to the flora expected from construction and operation.

To make recommendations on mitigation of expected negative impacts on vegetation during construction and operational phases.

2 APPROACH

The study comprised:

- Review of relevant information, including known plant species distribution according to the National Herbarium Database (SPMNDB) and species and area conservation status.
- One site visit and field survey of the proposed routes to and from the Obib substation, undertaken during March 2005.
- Preparation of a field report.

Nomenclature largely follows Craven (Ed.) 1999. Specimens collected for determination will be deposited in the collection of the National Herbarium in Windhoek.

3 LEGAL AND POLICY REQUIREMENTS

3.1 Acts and ordinances

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

3.2 Namibian commitment to international standards and/or guidelines

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

3.3 National policies and guidelines

The Sperrgebiet is soon to be gazetted as a national park. A land-use plan has been drawn up for the area, and the areas affected by the power line routes are zoned as follows (Figure 4-2).

The coastal plains east of the Uubvlei site, fall into Zone 6, a Managed Resource Protected Area. These areas are to be managed mainly for the sustainable use of natural ecosystems in the long term, thus they should be available in future for some land use that meets the objectives of the protected area.

The Schakalberge *per se* fall into Zone 1a, which encompasses areas where scientific knowledge is patchy and which are to be set aside for scientific study until their environmental importance has been clarified. This is thus a no-go area for the time being.

The area north-west of the Schakalberge falls into Zone 1b, a low-usage core area where no, or minimal, mechanized access is allowed.

The area from the Obib dunes to Rosh Pinah falls into Zone 2, National Park. These areas are managed for conservation and eco-tourism. Slightly more public usage is allowed, including controlled vehicle access, but no permanent structures.

4 DESCRIPTION OF SURVEYED AREAS AND RECOMMENDATIONS

The greater area concerned falls into the northern section of the Succulent Karoo Biom, which is regarded as a global biodiversity hotspot. It is thus important in global, as well as national, terms, especially also due to its largely pristine nature as a result of protection for the diamond mining industry over several decades. It falls within the Desert and Succulent Steppe as defined by Giess (1971). Winter and summer rains are possible, with rainfall averaging 51 mm per annum, increasing eastwards, and coastal fog playing an important role in the moisture regime of many organisms. Due to oceanic influences temperatures are moderate compared with much of Namibia, with mean daily temperature approximately 22°C. Winds, which are often very strong, occur throughout the year, mainly from the south-west, although warm north-easterly winds occur sporadically during winter. Terrestrial habitats that could be affected by the proposed development include coastal hummocks and plains, dunes, sandy plains, and several rocky koppies near the Obib substation.

Six broad zones were defined (A – F), based on overall habitat type and dominant species present. Each was assigned a conservation rating of 1 (least sensitive) to 5 (highly sensitive).

4.1 Coastal plains and stabilised hummocks (Zone A)

This area, which stretches from the Uubvlei site within mining area 1 as far as Swartbult on the blue route, and to approximately 28° 17.83' S and 16° 20.82' E on the green route, is composed of a patchwork of coastal gravelly-sandy plains and stabilised hummocky areas. Along the green route there are far larger hummocks, where a large woody *Stoeberia* is common and the vegetation is far denser. Less diverse areas of sandy hummocks dominated by the grass *Cladoraphis cyperoides* intervene occasionally towards the western sections near the Uubvlei site.

The vegetation is dominated by low-growing succulents such as *Brownanthus marlothii, B. arenosus, Stoeberia beetzii, Eberlanzia sedoides, Salsola* sp. and *Zygophyllum clavatum.* Species composition varies slightly from area to area, with other common species being *Othonna furcata, Sarcocaulon patersonii, Cephalophyllum ebracteatum, Eberlanzia sedoides, Mesembryanthemum cryptanthum, M. guerichianum, Drosanthemum luederitzii, Lycium tetrandrum, Salsola* sp., *Cladoraphis cyperoides* and *Lebeckia multiflora*.

The vegetation in this zone, including the section east of the Uubvlei site in Mining Area 1, is largely undisturbed. The assemblage of species is typical of the coastal plains, which include stabilised hummocky areas.

Protected species observed in, or listed for, Zone A are shown in Table 1.

Table 1: Species of conservation concern observed in, or listed for, Zone A

Family	Species	Endemic (E)/near-endemic (nE)	Protected (P)	Red Data status, rarity
Aizoaceae	*Cephalophyllum ebracteatum*	nE	P	LRlc
	Eberlanzia sedoides	E	P	LRnt
	Fenestraria rhopallophylla subsp. *aurantiaca*	nE	P	NT
	Juttadinteria deserticola	E	P	LRlc
Apocynaceae	*Stapelia gariepensis*	nE	P	LRnt
	Tridentea pachyrrhiza	nE	P	LRlc
	Tromotriche aperta	E	P	DD
Crassulaceae	*Crassula atropurpurea* var. *cultriformis*	nE	P	Rare
	Crassula plegmatoides	nE	P	LC

***LRnt** = Lower Risk-Near Threatened; **LRlc** = Lower Risk-Least Concern; **NT** = Near Threatened; **LC** = Least Concern; **DD** = Data Deficient*

Most of the plant species observed here are found in similar habitats along the coast of the southern Namib, but as several of the species are endemics, and/or protected (Table 1), and *J. deserticola* and *T. pachyrrhiza* are thought to occur at a very low density throughout their ranges, it is absolutely essential that unnecessary collateral damage, particularly that due to uncontrolled vehicle activity should be held to a minimum by usage of strictly designated access roads and turning points. This is additionally important because several more species of conservation concern have been recorded in this area previously, although they were not seen during the survey (Table 1). These include the endemic red data species *Tromotriche aperta* and *Euphorbia cibdela,* as well as *Stapelia gariepensis,* a protected species. The undisturbed nature of this zone, as well as occurrence of species of high conservation importance makes it unacceptable as a construction laydown and accommodation site, particularly as previously disturbed areas are available and suitable for that purpose to the south of the plant site.

Impacts on this vegetation type may be expected during construction and operational phases, because it will be traversed by several power lines and service tracks. In order to minimize disturbance, routes and turning points should be identified and demarcated before construction activities commence and the making of new tracks due to corrugations or any other excuses should be strictly prohibited. Offenders should be subject to penalties. East of 28° 24.45' S and 16° 20.14' E, and continuing until the turning point at Swartbult is a zone rich in *Crassula atropurpurea* var. *cultriformis* (Figure 4-1 and Figure 4-2) and *C. plegmatoides* (Figure 4-3). If the blue route is chosen then as few as possible turning points and no campsites should be designated in this stretch of track.

Conservation rating: 4

Figure 4-1: *Crassula atropurpurea* var. *cultriformis*

Figure 4-2: *Area before Swartbult, rich in C. atropurpurea var. cultriformis*

Figure 4-3: *Crassula plegmatoides*

If sufficient control is exercised then loss of protected species will be minimized, and later recolonisation of damaged areas, excluding service tracks, may be expected, reducing long-term defacement, and restoring reasonably natural habitats and ecosystems.

4.2 Unstabilised gravel and sand flats and hummocks (Zone B)

On the blue route from the turning point at Swartbult to the footslopes of the Schakalberge the prevailing habitat is one of gravelly-sandy flats and slopes and dune hummocks. Similar habitat is found along the green route south from the Schakalberge to the western edge of the large stabilized north-south orientated dunes in the vicinity of 28° 14.70' S and 16° 22.96' E, near Dippenaarskop.

This sandy zone is dominated by common species such as *Cladoraphis spinosa, Zygophyllum retrofractum, Z. clavatum, Brownanthus arenosus, Salsola sp., Othonna furcata, Aridaria brevicarpa* and *Phyllobolus oculatus* (Figure 4-4 and Figure 4-5). No species of high conservation concern were observed. Diversity drops closer to the Schakalberge, and just before the footslopes there is an extensive area where only three species predominate – *Cladoraphis spinosa, Othonna furcata* and *Salsola* sp. The area at the edge of the footslopes comprises mobile dunes where only *Salsola* sp. was observed.

Figure 4-4: *Sandy hummocks dominated by Cladoraphis spinosa and Brownanthus Renosus*

Figure 4-5: *Gravelly-sandy flat dominated by Brownanthus arenosus*

Zone B is not a sensitive area from a vegetation aspect. See recommendations in section 5.
Conservation rating: 1

4.3 Grassy plains and footslopes (Zone C)

The valley to the west of the Schakalberge (Figure 6) is dominated by *Stipagrostis geminifolia*, a common southern African grass. A similar grassy plain, interspersed with *Brownanthus* cf. *pseudoschlichtianus* and *Phyllobolus oculatus* lies between Z6B and Z12 to the north-east. The more gravelly footslopes support large numbers of *Zygophyllum clavatum* shrublets, *Phyllobolus oculatus* and *Augea capensis*, a common annual succulent.

This habitat continues beyond the Schakalberge ridge until it reaches a rocky koppie at 27° 55.74' S and 16° 30.07' E. **This koppie supports a far higher plant diversity than the surrounding plains, and should be avoided if at all possible.** Beyond the rocky koppie the grassy plain continues for a short while, gradually becoming more sandy, until it encounters a short stretch of dwarf succulents in a valley that stretches approximately from Z9 to just beyond Z13. This succulent valley will be discussed in section 4.6 (Zone F).

Diversity is far higher on the mountain slopes, where numerous endemic, protected and red data species are listed. These were not assessed because the proposed routes bypass the mountains.

Figure 4-6: *Low diversity on plains below the Schakalberge*

Providing the route is planned such that future developments (i.e. the second phase) are not forced by the location of the first phase to impinge on the mountains and koppies, Zone C is not a sensitive area from a vegetation aspect. This will probably involve moving the line a few hundred metres further down the valley slope west of the Schakalberge, away from the mountains, and carrying it slightly further north (to bend point Z6B rather than Z6). See also recommendations under section 5.

Conservation rating: **1**, providing the koppies and mountains are avoided.

4.4 Dunefields (Zone D)

At Z10 a dunefield interspersed by sandy dune valleys is encountered, and continues until a blue dolomite koppie is reached at approximately 27°52.36' S and 16°33.00' E.

Vegetation on the dunes is not very diverse, mainly the protected, near-endemic !nara, *Acanthosicyos horridus, Limeum fenestratum, Hermannia gariepina* and occasionally *Cladoraphis spinosa.* Thus, in general this is not a sensitive zone. However, at one or two spots too small to zone individually the diversity is far higher, and includes species such as *Zygophyllum prismatocarpum, Z. patenticaule, Sarcocaulon patersonii, Othonna cylindrifolia, Pteronia pomonae* and *Didelta carnosa* subsp. *tomentosa* (Figure 4-7).

Figure 4-7: *Higher diversity spot in the dune zone (Zone D) with the tall Zygophyllum prismatocarpum in the background*

Although the species in the high diversity spots are not species of very high conservation concern, several have restricted distributions in Namibia, and it would obviously be preferable that turning-points and campsites be placed where diversity is lower.

Acanthosicyos horridus is a protected species, but is widespread. In this area the individuals are spread out in a more-or-less linear fashion along the edge of the dune field, which will be crossed at a short tangent by the power line route. It is thus anticipated that only a few individuals are likely to be affected, and no mitigation measures are necessary. However, see recommendations under section 5.

Conservation rating: 2

4.5 Grassy plains east of Obib (Zone E)

Beyond the dune fields and the dolomite koppie, grassy/sandy plains are traversed until a saddle at 27°50.78' S and 16°37.05' E is reached. One other sandy ridge between two koppies is also traversed south of Skorpion Zinc.

These plains are dominated by *Stipagrostis* spp. and other grasses. Remnants of annual daisies such as *Foveolina dichotoma* were also seen. One rare species, *Haemanthus pubescens* subsp. *arenicola* (Figure 4-9) was collected on the plains beyond the dolomite koppie. More diverse areas surround these plains, mainly on footslopes of koppies. The koppies themselves were not assessed as it was not indicated that they would be affected by the power lines, but in this area rocky areas are well known and documented to harbour a high species diversity as well as many protected and endemic species.

The area between the last koppie and the substation was not assessed, as it was not possible to leave the security area.

Figure 4-8: *Grassy plains near Obib*

Figure 4-9: *Haemanthus pubescens subsp. arenicola, a rare geophyte found blooming on the grassy plains west of Obib*

It is not possible to assess the status of the rare species found, because it is data deficient. However, it is known to have a restricted distribution and must be regarded as a conservation concern. As recommended in section 5, control of unnecessary tracks, turning points and collateral damage is of the utmost importance. Planning to accommodate later expansion in phase 2 must take into account the higher diversity on the footslopes and koppies, as well as the koppies on either side of the two saddles that are traversed.

Conservation rating: 3

4.6 Succulent valley (Zone F)

As previously mentioned, a valley plain dominated by dwarf succulents lies between Z13 and Z12.

Common species found here are *Eberlanzia sedoides* (a near-threatened species), *Othonna* sp., *Brownanthus* cf. *pseudoschlichtianus, Stipagrostis geminifolia* and *Pteronia pomonae*. The near-endemic *Euphorbia melanohydrata* was also found. This zone was investigated as a possible alternative route.

Figure 4-10: *Euphorbia melanohydrata*

No species of known conservation concern were encountered, but *E. melanohydrata* (Figure 9) has a limited distribution in Namibia, and has already been adversely affected by the Skorpion development and Rosh Pinah town expansion. As its exact status in Namibia is somewhat uncertain at present, the precautionary principal must apply and it should be regarded as of possible conservation concern. This again requires the strictest control of tracks and turning points. If possible individuals should be relocated. See comments in section 5.

A power line along this valley will probably be visible from the Obib area, which has high tourism potential.

Conservation rating: 3

5 GENERAL RECOMMENDATIONS

By far the greatest damage will be done by vehicles during the construction phase. In order to minimize disturbance, routes and turning points should be identified and demarcated before construction activities commence along each section and the making of new tracks due to corrugations or any other excuses should be strictly prohibited. Offenders should be subject to penalties. Please refer to the constraints section (section 6).

Collection of plants, seeds or any other parts of plants should be strictly prohibited.

The appointment of a **knowledgeable** environmental officer **with authority**, particularly during the construction phase is highly recommended. Previous experience has indicated that this would probably be the only successful way to ensure compliance of contractors with recommendations of the environmental management plan (EMP). Contractors should be educated regarding the EMP for the construction phase, and should face fixed penalties for transgressions.

Fuel collection will be of concern. Serious consideration should be given to low-cost fuel provision to prevent vegetation degradation. Possible sources include wood from clearing of alien vegetation elsewhere in Namibia or provision of alternative fuel sources for heating and cooking, such as paraffin or gas.

From a vegetation aspect the blue route is slightly preferable to the green route. This is because Zone A is more densely vegetated and more diverse along the green route.

6 CONSTRAINTS

The fieldwork in this area should ideally be done during the rainy season, i.e. in winter. During the summer no annuals are present, and very few geophytes. The area is known to support a high diversity of geophytes, many of which are rare. A large proportion of these grow in sandy areas such as those that will be traversed by the power lines, and these have thus DEFINITELY BEEN UNDERREPRESENTED in this survey. THIS ADDS TO THE MPORTANCE OF TRACK CONTROL DURING CONSTRUCTION AND OPERATION.

7 SUMMARY

No plant species of sufficient conservation concern were found in any of the above habitats to warrant rejection of any of the routes proposed, or to justify any costly rescue operations. Nevertheless, habitat destruction along the southern Namib coast has already been considerable, and the route is to traverse an almost pristine designated wilderness area. It is morally important that disturbance should be held to a minimum, that an environmentally sensitive attitude to this valuable area be fostered amongst all staff. Issues of scenic vistas in the wilderness zones should be taken into consideration when selecting the final route.

Most of the damage to vegetation is likely to be due to vehicles during the construction phase. Careful planning and demarcation of access routes prior to construction, together with enforcement of guidelines, will go a long way towards limiting this damage, and conserving as much of the natural habitat as possible.

8 REFERENCES

Craven, P. (Ed.) 1999. Checklist of Namibian Plant Species. SABONET Report No. 7. SABONET, Windhoek.

Giess, W. 1971. A preliminary vegetation map of Namibia *Dinteria* 4: 5-114.

Ministry of Environment and Tourism (2001). *The Sperrgebiet Land Use Plan* (2nd Draft). Directorate of Environmental Affairs, Windhoek.

National Herbarium of Namibia. Undated. Specimen Database. National Botanical Research Institute, Windhoek.

APPENDIX 5

TERRESTRIAL ECOLOGICAL ASSESSMENT

UPDATING OF AN ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN OF THE POWER LINES FROM THE KUDU GAS POWER STATION (UUBVLEI SITE) TO ORANJEMOND AND OBIB RESPECTIVELY

SPECIALIST CONSTRIBUTION:

GENERAL TERRESTRIAL ECOLOGY AND FAUNA (EXCLUDING BIRDS)

Prepared by:

ENVIRONMENTAL EVALUATION ASSOCIATES OF NAMIBIA (Pty) Ltd
P O Box 20232
Windhoek

Tel: 061-229855
Fax: 061-230172
Email: johnp@drfn.org.na

Prepared for:

ENVIRO DYNAMICS
ENVIRONMENTAL MANAGEMENT CONSULTANTS

P O Box 20837
WINDHOEK
Namibia
Telephone: +264-61-223336
Telefax: +264-61-240309
E-mail: envirod@africaonline.com.na

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Background

NamPower is proposing 4 new power lines in the vicinity of Oranjemund:

1. A 220 KV power line from the proposed new Kudu Gas Power Station at Uubvlei to the Northbank Substation, where the line will cross the Orange River to the Oranjemond Substation in RSA. This will connect the power station to the 220kV network that feeds the Oranjemund - Alexander Bay area.
2. A 400 KV power line along the same route. This will be the main feed for electricity into the South African grid.
3. A 400 KV power line from the proposed Kudu Gas Power Station heading northeastwards diagonally across the southern Sperrgebiet to Obib Substation near Rosh Pinah. This will be the main feed for electricity into the Namibian grid.
4. Another 400 KV power line along the same route, that will be erected in future if the Kudu Gas Power Station is upgraded. This will only occur if gas reserves become proven for expansion of the power station, so the line will only be erected if and when this occurs.

The present proposed alignment of the routes is shown in Figure 1. The power line routes are indicated as follows:

Uubvlei – Obib straight line: green to Z3, blue to Obib

Uubvlei – Z3 via Swartbult (preferred route): blue

Z3 – Obib avoiding Schakalberg: (preferred route)— red or black

~~Z3 – Obib via Schakalsberg and avoiding sensitive points (preferred route): green~~

Uubvlei – Northbank via Swartbult blue, with detour in red

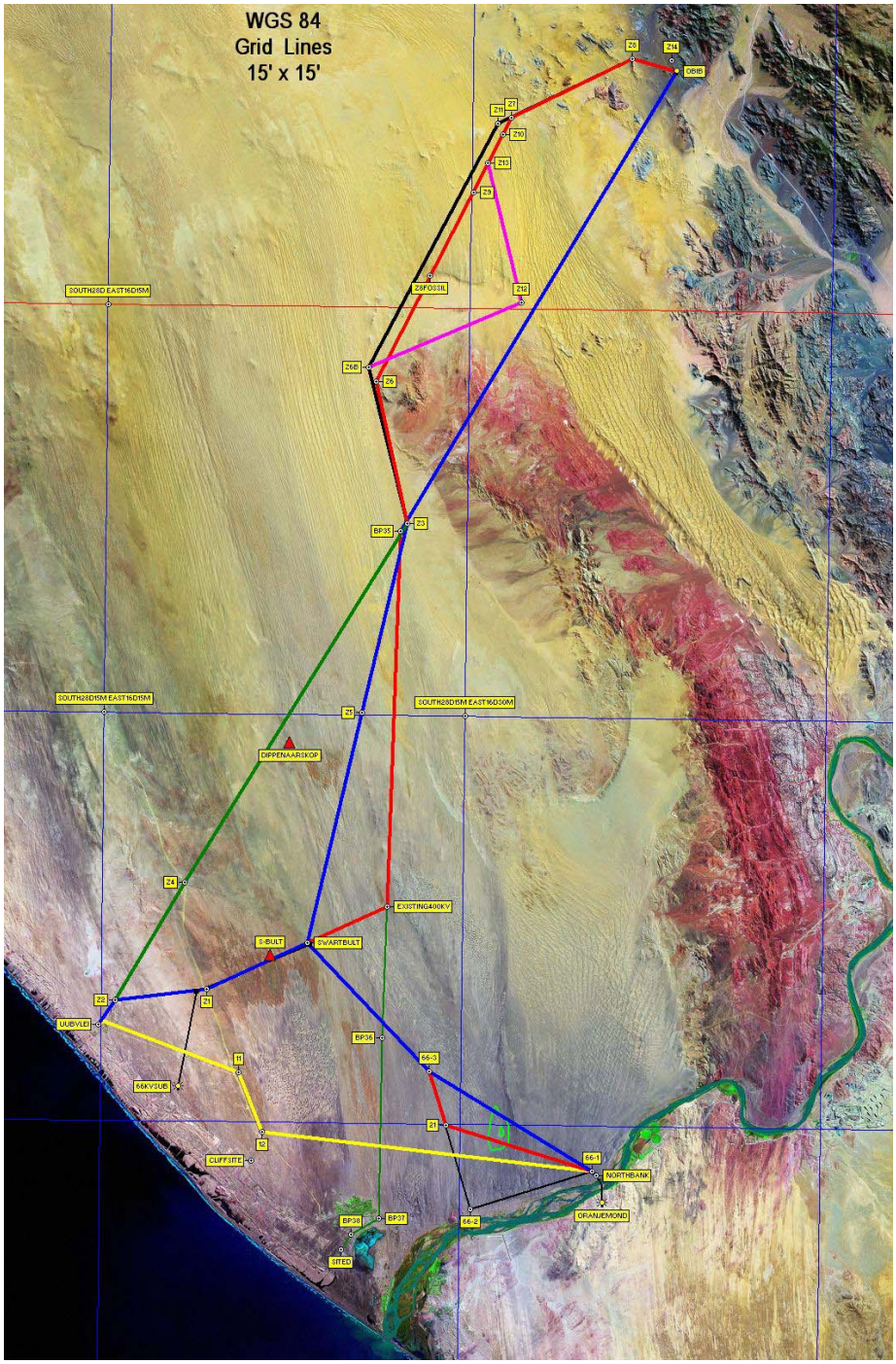


Figure 1. Alignment of proposed alternatives for power lines linked to the proposed Kudu Gas Power Station at Uubvlei.

1.2 Terms of reference

This EIA is a review and update of previous EIAs and EMP, based on fieldwork conducted in April 2005. Clauses of the ToR that are relevant to the terrestrial ecology and non-bird fauna component are as follows:

- Because of the fact that earlier studies have already been done, the consultant shall not be required to consider the need for the new power lines, but s/he must critique the environmental acceptability of constructing and maintaining the lines along the preferred routes, using criteria such as (but not limited to) aesthetic impacts, proximity to the town, proximity to airfields, disturbance of areas deemed important for the support of farming, tourism and biodiversity, impacts on birdlife, disturbance to archaeological sites and risks associated with unsuitable gradients, substrates and flooding.

- Special consideration shall be given to conservation and tourism issues in the proposed Sperrgebiet National Park, the Orange River Mouth wetland and adjacent areas. South-western Namibia is regarded as a key area for transfrontier conservation and tourism initiatives. (The Orange River is shared by Namibia and South Africa, and joint conservation activities are contemplated in the Ai-Ais/Huns Mountains – Richtersveld areas.)

- If the consultant is of the opinion that the preferred routes, or some stretches of the routes identified as acceptable during previous studies, are not acceptable environmentally, s/he shall, in consultation with NamPower, propose alternative routes, citing reasons for the proposed alternative(s).

1.3 Criteria for assessing impacts

The following terms and criteria are used in this report:

Nature of impact:	The type of effect that a proposed activity will have on the environment. A narrative of the impact.
Extent:	Geographic area. Whether the impact will be within a limited area (on site and immediate surroundings, LIM)), locally (within the power line corridor; L), regionally (R), nationally (N) or internationally (I).
Duration:	Whether the impact will be temporary (during implementation only; T), short term (1-5 years; ST), medium term (5-10 years; MT), long term (longer than 10 years, but will cease after operation LT), permanent (P) or transient (TR).
Intensity:	Whether the impact is destructive or harmless. Low (L) where no environmental functions and processes are affected, Moderate (M) where the environment continues to function but in a modified manner or High (H) (environmental functions and processes are altered VH Environmental processes cease completely. May also be measured in accordance with acceptable standards, applicable conventions, best practice policy, levels of social acceptance, etc
Probability:	The probability that a certain impact will in fact realise; Uncertain (U), Improbable (I), Probable (P); Highly Probable (HP); Certain (C). If the probability is uncertain, then there is not sufficient information to determine its probability. Because the precautionary principle is followed, this increases the significance of the impact.

Mitigation:	The possibility to mitigate the impact. Completely (C), Satisfactory (S), Limited (L), None (N).
Status:	Negative, positive or neutral
Significance:	Low if the impact will not have an influence on the decision or require to be significantly accommodated in the project design, Moderate if the impact could have an influence on the environment which will require modification of the project design or alternative mitigation (the route can be used, but with deviations or mitigation) High where it could have a "no-go" implication regardless of any possible mitigation (an alternative route should be used).

The impact evaluation takes into consideration cumulative impacts associated with this and other projects which are either developed or in the process of being developed in the area or region.

2 DESCRIPTION OF AFFECTED ENVIRONMENT AND FAUNA

The distribution of habitats that the power lines will cross are shown in the vegetation report for this EIA. Defining the boundaries of the zones is difficult because the zones blend into one another and because in many cases they form a fine mosaic of patches on a scale that is too small to show on a large-scale map.

As in the rest of the Namib, the Sperrgebiet is home to a very diverse fauna that reflects the adaptations of various animals to the diverse habitats. For instance, there are fog-dependent frogs, an impressive 80 species of reptiles that are their most diverse in the geckos, skinks and sand lizards that make use of different zones in dunes and the kinds of substrate they offer for shelter and refuge, and 20 species of rodents (Griffin 1995). The Sperrgebiet, especially in the south, being a winter-rainfall area, differs from the central Namib sand sea in its abundance of vegetation, even through the dry season. The succulent plants provide a relatively steady source of food and shelter for arthropods and small vertebrate animals such as lizards and mice. Thus total species numbers for these groups in the Sperrgebiet are higher than in the central Namib. Also, animals that are more abundant in the mountainous areas to the east of the Sperrgebiet are found marginally in the rocky outcrops and inselbergs of the Sperrgebiet itself, adding to the diversity (Pallett 1995).

Lists of amphibian, reptile and mammal species that can be expected or are known to occur in the project area, compiled using the Sperrgebiet list of Griffin (1995) are shown in Appendix A. This provides details of the animals that may be encountered during project implementation, and can be used to alert the people involved in what to look out for. The list also provides information on the preferred habitats and conservation status of the animals.

Species listed as endemic are endemic to Namibia, not necessarily endemic to the Sperrgebiet itself or the project area *per se*. Due to the poor coverage of animal collecting in the Sperrgebiet, the ranges of many species are estimations based on scattered and/or isolated records, very often at the edges of the Sperrgebiet such as along the eastern boundary and south of the Orange River. So knowledge is quite limited, making prediction of impacts of the power lines on the fauna more difficult.

2.1 Coastal plains and hummocks

Uubvlei, the starting point of the power lines, is situated in an area of low hummocks, and this habitat type is widespread in the Sperrgebiet within about 5 km of the coast. PIC 1 Large parts of this habitat within Mining Area 1 have been disturbed or severely degraded by diamond mining operations. Further inland, up to about 15 km from the coast, hummocks are less distinct and the substrate is gravely-sandy plains

The low hummocks form around low woody and bushy plants, such as *Stoeberia, Salsola* and *Brownanthus,* that grow as 'cushions' up to about 0.5m high. Lichens are an important feature in this habitat, growing on the woody stems and leaves of the plants. Lichens in general in Namibia are poorly known, and this area even less because of the restrictions of Diamond Area 1 (Wessels 1994), so it is not known if any species are endemic to a limited area here, or are of any conservation significance for other reasons.

On the fauna side, most of the ecological action in this area, like in much of the Namib, is carried out by small animals that can shelter from the harsh conditions of strong winds and meagre rainfall, and that can take advantage of the moisture provided by fog. Evidence of animal activity is seen in spider webs in most of the plants, tracks of snails, beetles, lizards, snakes, larks and hares on the ground, tracks of beetle larvae and legless lizards just beneath the surface, burrows of scorpions and small rodents, and various other signs of cryptic life.

The habitat supports a well-developed, mainly sand-living invertebrate fauna with a large but unspecified number of endemic species (Marais 1998).

Two frog species, desert rain frog and Namaqua rain frog, are found in this habitat. The former, *Breviceps macrops*, is noteworthy as it might even be a separate species from adjacent Namaqualand populations. If this is the case, Namibian responsibility for this species, (presently classified as Insufficiently Known & Endemic, Griffin 1999) would increase considerably (Griffin 1998). This unusual frog depends on fog moisture, confining it to a thin belt close to the coast, and lives in sandy hummock habitat in the Sperrgebiet only, much of which has been or will be destroyed in diamond mining operations.

Amongst reptiles, species of concern are the Namaqua dwarf adder (*Bitis schneideri*), and classified as Insufficiently Known [Griffin 1999]) and possibly some underground-living lizards (legless skinks of the genus *Acontias* and *Typhlosaurus*) which have still to be confirmed. Namaqua dwarf adder is known to occur in two colour morphs, one found in the coastal zone, the other more inland (Cunningham pers. comm.). The coastal morph is very pale (that matches the colour of coastal sands) and the other much darker, a more brick-red colour (that matches the colour of sands inland). It is not known whether these are separate species or possible sub-species.

The pale-morph Namaqua dwarf adder and one species of legless skink are ~~These species are also~~ confined to the coastal vegetated hummock habitat, and are thus threatened by mining activities (Griffin 1998).

All of the mammals of conservation significance that occur in this habitat have distributions that extend well beyond the project area.

2.2 Unstabilised gravel and sand flats and low dunes

Areas to the east of the coastal plains comprise gravely and sandy flats, low dunes and hummocks, and dunes proper. The substrate is variable: in some places it is firm, even hard in the case of consolidated fossil dunes, in others very loose and fine-grained, such as on dunes. In the majority of places it is semi-stabilised by low succulent shrub vegetation and grasses (Burke 1998). PICS 2, 3, 4

Invertebrate fauna comprises the wealth of insects, spiders and scorpions that are adapted to living in and on sand, for which the Namib is renowned. The same goes for species of reptiles and small mammals. Although the sandy substrate is not so clearly sculptured into dunes in this area as occurs further north in the central Namib sand sea, the areas are continuous with each other and there are unlikely to be any animal species with restricted geographic distributions here. PIC 5

The species lists show that there are 49 reptile species and 41 mammal species known or expected to occur in this habitat. Some of these species (e.g. veld leguaan, yellow mongoose) are probably found here only when good rainfalls allow expansion of their ranges westwards into the desert proper. Of the reptile species, three are of conservation concern: the leopard tortoise, tent tortoise and veld leguaan. Amongst the mammals, 8 species are of conservation concern: seven of these are carnivores that are persecuted by farmers, and the last, the small grey mongoose, is probably a vagrant in this area. Persecution is not an issue in the Sperrgebiet, so the cause of their status as Vulnerable does not apply in the project area. Nevertheless, their populations should not be disturbed, as set out in the mitigatory actions suggested below.

2.3 Rocky outcrops and inselbergs

Areas of rocky outcrop occur sporadically throughout the project area. These form small rises and low hills usually flanked by accumulated sand, and the large Schakalberg mountain is a very prominent feature of the area. Their geology and vegetation vary, but the significant feature is that they catch moisture from fog precipitation and retain it in crevices and cracks in the rocks, so support greater densities and varieties of plants than the surrounding sandy areas. PIC 6 These in turn support more fauna. The rocky outcrops, inselbergs and mountains are therefore the most sensitive habitats in the project area, and should be avoided as much as possible.

The red marble frog uses rock pools to breed and hides in crevices during the long dry season. Twenty-two species of reptiles in the project area depend on rocky substrates. Of these, eight are endemic to Namibia, and none are known to be threatened. However, caution is advised for two species, rough-scaled gecko and dwarf mountain adder, which are insufficiently known to be able to give reliable estimates of their conservation status.

Twenty-two species of mammals in the project area depend on rocky substrates and mountainous terrain: half of them require proper mountains providing caves, shelters and high relief such as is found on Schakalberg (e.g. bats, leopard, Hartmann's mountain zebra), while the others use rocky substrate for the firm substrate it provides to burrow into. Hartmann's mountain zebra is the only species in this group that is classified as Vulnerable, and there are three species that are endemic to Namibia.

2.4 Sperrgebiet land-use zones

The Sperrgebiet has undergone a process of land-use planning and is expected to be proclaimed as a national park in the near future (in 2005 if it goes to schedule). The power lines will traverse areas that are to be managed for ecotourism and conservation, and wilderness areas where no mechanised access is allowed. Routing of the power lines has been done to minimise the distances where they traverse these zones and to minimise their visibility from areas where there may be future wilderness-based tourism.

3 ENVIRONMENTAL IMPACTS CAUSED BY CONSTRUCTION OF THE POWER LINES AND SUGGESTED MITIGATORY ACTIONS

3.1 Disturbance to fauna

Obviously, construction will involve earth-moving and damage to plants and animals in the process of making tracks, clearing vegetation around the feet of the pylons, vehicles driving along the route during surveying, erection of pylons and hanging the wires, and similar impacts of construction activities. Poorly supervised contractors and/or poor management of the construction process could lead to the area of disturbance to animals being much wider than necessary.

While animal species occurring in the sandy and hummock habitats generally have wide distributions, those that are found on rocky outcrops and mountains are much more habitat-specific and have more restricted distributions. This is the main reason for routing the power line to avoid, as much as possible, traversing outcrops and mountainous terrain.

It is recommended that construction activities must be confined to the immediate area of each pylon and the straight line path between them, to prevent the disturbance spreading outwards unnecessarily. ~~Vehicle tracks in this habitat stay visible for a long time, up to decades, and so these should be kept to an absolute minimum.~~ Conscientious and thorough supervision of contractors and their activities will greatly help to prevent unnecessary damage. For this purpose, appointment of an 'environmental supervisor' to oversee the work of the contractors will facilitate the process.

As long as the 'footprint' of the power line is reduced to the minimum through close supervision of the construction process, and is routed to avoid traversing rocky outcrops, the disturbance will affect only a thin linear strip traversing this large expansive sandy area. This impact is not viewed as significant to the fauna, in the broad picture.

Disturbance to fauna	CONSTRUCTION	
	Before Mitigation	**After Mitigation**
Status	Small negative impact	Small negative impact
Extent	If construction is poorly managed or supervised, could be much wider than the path of the power line and also affect areas where contractors drive unnecessarily.	Through proper site management, can be restricted to an area approx 5m wide along route, and approx 10m radius circle around pylons.
Duration	Temporary, during construction only	Temporary, during construction only
Intensity	Low	Low
Probability	Certain	Certain
Mitigation	Satisfactory	
Overall significance	Low	Low

3.2 Trapping and killing of wildlife

Introduction of workers into an area where large animals such as gemsbok and springbok roam freely is bound to result in attempts to poach them, most likely using snares. Opportunities to poach will mainly arise if workers have lots of free time on site. If they are occupied whilst in the area, and, where possible, transported out of the area over weekends, the chances to poach or lay traps will be greatly reduced, but not altogether removed.

A less conspicuous form of removal of animals is possible through people picking up tortoises and taking them out of the area to keep, or eating them on site. Apart from being illegal, this action further threatens species that are already classified as Vulnerable (in the case of leopard tortoise) or possibly Rare (in the case of padlopers or tent tortoise).

Another issue is unnecessary killing of animals such as snakes and scorpions. While some of these animals are obviously dangerous, most will not pose any danger if they are left alone or allowed to get out of harm's way at their own pace. Killing of such animals is unnecessary and should be forbidden. While the impact of this action is unlikely to pose any danger to populations of specific species in the project area, it will add to the decline of some threatened species such as the Namaqua dwarf sand adder.

This impact can be mitigated by close supervision of the labour force during construction, and by keeping to a minimum the amount of free time that the work force spends in the Sperrgebiet. ~~accommodating labourers in Oranjemund or Rosh Pinah when they have free days.~~

Trapping and killing of wildlife	CONSTRUCTION	
	Before Mitigation	**After Mitigation**
Status	Negative	Neutral – negative
Extent	Local within the power line corridor	Local
Duration	Temporary	Temporary
Intensity	Low – medium	Low
Probability	Probable	Probable
Mitigation	Satisfactory	
Overall significance	Low	Low

3.3 Spoiling the wilderness appeal and future tourism potential

In the eyes of people who, in future, might visit the Sperrgebiet for its wilderness appeal and its pristine landscapes, the power line represents an ugly man-made structure that detracts from the 'sense of place' and aesthetic beauty of the landscape. One of Namibia's prime features, and mentioned in Vision 2030 as one of its 'competitive advantages', is its wide open, unspoilt vistas and areas of unspoilt wilderness, which are a declining asset all over the world and one that Namibia should capitalise on.

The power line might reduce the wilderness appeal of this area and therefore jeopardise the potential for this area to attract future exclusive, wilderness-based tourism. This is the prime motivation for routing the power line along low ground to reduce its visibility, and avoiding focal areas of interest such as the Schakalberg.

Vehicle tracks created during construction of the power line and used for its future maintenance will also detract from the wilderness appeal, as they stay visible on the ground for a long time, up to 20 or 30 years, and increase the scar on the landscape that the power line creates. Vehicle tracks must therefore be kept to an absolute minimum and should not diverge away from the route of the power line. PIC 8 Access to the power line during construction should only be allowed from the eastern and western ends, so that heavy vehicles and machinery do not travel on other roads in the Sperrgebiet where track scars must be prevented.

As far as possible, construction workers should not be allowed to overnight in the Sperrgebiet. In practical terms, it will be impossible to drive in to the central sections of the routes every day, and drive out again before nightfall. It is therefore recommended that no more than three construction camps are set up within the Sperrgebiet. On the Uubvlei to Obib line: one between Swartbult and Schakalberg (point Z6B), and one between Schakalberg (Z6B) and point Z9. On the Uubvlei to Northbank line, somewhere close to point 66-3. This means the travelling distance from overnight camp to any place on the

power line never exceeds 20 km. The precise situation of construction camps should be decided in consultation with the above-mentioned environmental supervisor. They should be sited away from rocky outcrops, in areas of sand flats where damage to the substrate and to vegetation will be covered by wind action and regrowth within a few years.

Workers should also be supplied with cooking fuel and appliances, such as camping gas appliances, so that there is no need to collect any fuel such as twigs and plants from the surroundings.

All rubbish and litter should be removed from the area, and properly disposed of in appropriate facilities in Oranjemund or Rosh Pinah. On no account should it be buried on site.

To reiterate: as long as the 'footprint' of the power line is reduced to the minimum through close supervision of the construction process, and the construction force is aware of issues such as track discipline, and they confine their activities to areas that are identified early on in the process, unnecessary damage can be avoided. Just one careless driver, or drunk episode with a vehicle, or someone taking a short cut in an emergency, can cause permanent scars, and it will not be fixed by any penalty or dismissal. The important point is to not allow it in the first place.

Spoiling the wilderness appeal by creating unnecessary vehicle tracks and scars from unnecessary activities around construction camps.	**CONSTRUCTION**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative but less severe
Extent	Possibly beyond the power line corridor	Local, within the power line corridor
Duration	Permanent	Permanent
Intensity	Medium - high	Low
Probability	Probable	Certain
Mitigation	Satisfactory	
Overall significance	Medium - high	Low

4 COMPARISON OF ENVIRONMENTAL IMPACTS OF ALTERNATIVE POWER LINE ROUTES, AND SUGGESTED MITIGATORY ACTIONS

The present proposed alignment of the routes is shown in Figure 1. The power line routes are indicated as follows:

Uubvlei – Z3 / BP35:
The green route from Uubvlei to Z3, a straight line, is similar to the longer route via Swartbult in terms of impacts on fauna. But the detour to Swartbult is preferred because this follows an existing power line, so there is a corridor of disturbance there already. Constructing a new line next to an existing one will create less negative impact, both during construction and when operational, than erecting a new line along a separate route.

Z3 – Obib:
The blue route from Z3 to Obib substation, going over the Schakalberg, is ruled out to avoid the sensitive mountain habitat.

The red or black routes, going to Z6 / Z6B, then Z7, Z8, Z14 and on to Obib, are preferred, so long as small adjustments can be made to avoid, as far as possible, the outcrops at Z8FOSSIL and Z9 and the dune at Z10. Noli suggests the black route would most effectively achieve this.

The pink route via Z12 is ruled out as it traverses reasonably high ground.

Uubvlei – Northbank via Swartbult~~The~~
The blue route from Uubvlei to Swartbult is discussed above. It continues towards Northbank with a bend at 66-3. The red detour to point 21 is similar to the blue line, except for the fact that it traverses a fossil site and GP pan. Reasons for taking this detour are linked with the value of the fossil site and GP pan, both of which could have potential for either future tourism or for Namdeb.

5 CONCLUSION

Environmental damage done in the Sperrgebiet during construction of the power line, and caused by it once it is in place, is mostly of an aesthetic nature. We are talking here of things like reducing the wilderness character of the wide open spaces, rather than issues that are significant to the ecological processes in the area.

Environmental damage of this sort is unavoidable, but can be kept to a minimum by taking appropriate care during construction. 'Appropriate care' means being constantly aware of the value of the unspoilt landscape, and acting to keep it that way as much as possible.

The construction workers who go into the area need to be aware of this before they go in. They also need to be given precise instructions and demonstrations so that there is no room for doubt about what is meant by 'keeping to vehicle tracks' and 'confining their activities to pre-determined areas'.

This sort of training could be given by an 'environmental supervisor' of the construction process. This person would ideally have a good feel for the area in the first place, and be

reliable in terms of her/his survival skills in the desert. S/he would instruct the work force about necessary measures, and would be involved in setting up the routes for entry and sites for construction camps in the project area. S/he would work closely with the construction team, especially in the beginning, to point out necessary precautions and also to provide broad environmental information about the area. Her/his role would be more than just monitoring the compliance of contractors, it would be pro-actively telling them about the valuable environmental features in the area, and sharing her/his knowledge in a spirit of cooperation rather than confrontation. However, any infringements would be quickly pointed out and punishment (in terms of penalty fees) immediately applied.

Formatted: Bullets and Numbering

6 REFERENCES

Cunningham, P. 2005. personal communication about the unresolved status of pale and dark colour morphs of *Bitis schneideri*.

Formatted

Griffin, M. 1995. Annotated checklist and conservation status of mammals, reptiles and amphibians of the Sperrgebiet, southern Namib Desert, Namibia. Unpublished report held by Namdeb: Sperrgebiet Specialist Study.

Griffin, M. 1999. Checklist and provisional national conservation status of amphibians, reptiles and mammals known or expected to occur in Namibia. Unpublished manuscript, Ministry of Environment and Tourism.

Marais, E. 1998. Entomological profile of the Oranjemund area, and considerations for selecting a site for the Kudu Power Station. Appendix 2.I in: Nampower (1998). Kudu Gas Power Project Preliminary Environmental Assessment.

Pallett J. (Ed.) 1995. The Sperrgebiet. Namibia's least known wilderness. An environmental profile of the Sperrgebiet or Diamond Area 1, in souther-western Namibia. DRFN and Namdeb, Windhoek, Namibia.

Wessels, D.C.J. 1994. Aspects of "Sperrgebiet" lichens. Unpublished report held by Namdeb. Sperrgebiet Specialist Studies: Lichens.

ANNEXURE 1

Common name	Scientific name	Distribution in Sperrgebiet	habitat	Occurrence	Conservation status
AMPHIBIANS					
Desert rain frog	*Breviceps macrops*	coastal	sandy substrate	not known	Insufficiently known, Endemic
Namaqua rain frog	*Breviceps namaquensis*	coastal	plant hummocks	NYR	Not listed
Red marbled frog	*Phrynomantis annectens*	throughout	rock pools, crevices	NYR	Endemic
Common sand frog	*Tomopterna cryptotis*	throughout	seasonal water	present	Secure
REPTILES					
Tortoises					
Angulate tortoise	*Chersina angulata*	throughout	hummocks	NYR	Secure
Leopard tortoise	*Geochelone pardalis*	eastern sector	any habitat	NYR	Vulnerable
Speckled padloper	*Homopus signatus*	southern sector	rocky	NYR	Not listed
Karoo padloper	*Homopus boulengeri*	southern sector	not known	NYR	Not listed
Nama padloper	*Homopus sp. nov.*	throughout	mountainous	present	Endemic
Tent tortoise	*Psammobates tentorius*	eastern sector	any habitat	present	Insufficiently known
Geckos					
Namaqua flat gecko	*Afroedura namaquensis*	eastern sector	rocky	NYR	Not listed
Giant ground gecko	*Chondrodactylus angulifer*	throughout	any habitat	present	Secure
Palmatogecko	*Palmatogecko rangei*	throughout	sandy soil	present	Endemic, Secure
Namaqua day gecko	*Phelsuma ocellata*	eastern sector	rocky	NYR	Peripheral
Common barking gecko	*Ptenopus garrulus*	throughout	sandy soil	present	Secure
Festive gecko	*Narudasia festiva*	eastern sector	rocky	NYR	Endemic, Secure
Southern dune gecko	*Pachydactylus austeni*	southern sector	coastal hummocks	NYR	Not listed
Keeled button-scaled gecko	*Pachydactylus bibronii*	throughout	any habitat	common	Secure
Western Cape gecko	*Pachdactylus labialis*	southern sector	succulent shrubs	NYR	Not listed
Smooth button-scaled gecko	*Pachydactylus laevigatus*	throughout	rocky	NYR	Endemic, Secure
Marico gecko	*Pachydactylus marigeunsis*	eastern sector	sand plains	NYR	Not listed
Namaqua gecko	*Pachydactylus namaquensis*	eastern sector	rocky	present	Secure
Speckled gecko	*Pachydactylus punctatus*	throughout	any habitat	present	Secure
Rough-scaled gecko	*Pachydactylus rugosus*	eastern sector	rocky	present	Endemic, Insufficiently known
Serval gecko	*Pachydactylus serval*	eastern sector	rocky	present	Secure
Western banded gecko	*Pachydactylus weberi*	eastern sector	rocky	present	Secure
Striped leaf-toed gecko	*Phyllodactylus lineatus*	eastern sector	rocky	present	Peripheral
Agamas					
Common ground agama	*Agama aculeata*	eastern sector	any habitat	present	Secure
Western rock agama	*Agama anchietae*	eastern sector	rocky	NYR	Secure
Southern rock agama	*Agama atra*	throughout	rocky	present	Secure
Spiny agama	*Agama hispida*	throughout	sandy soil	common	Secure

Common name	***Scientific name***	**Distribution in Sperrgebiet**	**habitat**	**Occurrence**	**Conservation status**
Chameleons					
Namaqua dwarf chameleon	*Bradypodion ventrale*	maybe, in isolated populations	bushes & shrubs	NYR	Not listed
Namaqua chameleon	*Chameleo namaquensis*	throughout	any habitat	present	Secure
Skinks					
Striped legless skink	*Acontias lineatus*	throughout	sandy soil	present	Secure
Thin-tailed legless skink	*Acontias gracilicauda*	southern sector	sandy soil	NYR	Not listed
Coastal legless skink	*Acontias litoralis*	coastal	dune hummocks	NYR	Not listed
Variable blind legless skink	*Typhlosaurus meyeri*	throughout	sandy soil	NYR	Endemic, Secure
Blind worm legless skink	*Typhlosaurus vermis*	southern sector	coastal dunes	NYR	Not listed
Western dwarf burrowing skink	*Scelotes capensis*	eastern sector	sandy soil	NYR	Endemic, Secure
Wedge-snouted skink	*Mabuya acutilabris*	throughout	sandy soil	NYR	Secure
Cape three-lined skink	*Mabuya capensis*	eastern sector	sandy soil	NYR	Secure
Western three-lined skink	*Mabuya occidentalis*	throughout	any habitat	NYR	Secure
Koppie skink	*Mabuya sulcata*	throughout	rocky	present	Endemic, Secure
Variegated skink	*Mabuya variegata*	throughout	any habitat	present	Secure
Lizards proper					
Robust desert lizard	*Meroles ctenodactylus*	throughout	gravel & sandy plains	present	Secure
Wedge-snouted desert lizard	*Meroles cuneirostris*	throughout	sandy soil	present	Endemic, Secure
Spotted desert lizard	*Meroles suborbitalis*	throughout	gravel & sandy plains	present	Secure
Cape desert lizard	*Meroles knoxii*	throughout	any habitat	present	Secure
Spotted sand lizard	*Pedioplanis lineoocellata*	throughout	stony soil	present	Secure
Namaqua sand lizard	*Pedioplanis namaquensis*	throughout	any habitat	NYR	Secure
Green-spotted sand lizard	*Pedioplanis inornata*	eastern sector	any habitat	NYR	Endemic, Secure
Cape sand lizard	*Pedioplanis laticeps*	throughout	any habitat	NYR	Peripheral
Striped sandveld lizard	*Nucras tessellata*	eastern sector	any habitat	present	Secure
Plated lizards					
Dwarf plated lizard	*Cordylosaurus subtessellatus*	eastern sector	rocky	present	Endemic, Secure
Namaqua plated lizard	*Gerrhosaurus typicus*	southern sector	not known	NYR	Not listed
Karoo girdled lizard	*Cordylus polyzonus*	throughout	rocky	present	Secure
Orange River flat lizard	*Platysaurus capensis*	eastern sector	rocky	present	Secure
Leguaans					
Veld leguaan	*Varanus exanthematicus*	eastern sector	any habitat	NYR	Insufficiently known
Snakes					
Western worm snake	*Leptotyphlops occidentalis*	eastern sector	not known	NYR	Endemic, Secure
	Typhlops lalandei	eastern sector	any habitat	NYR	Secure
Beaked blind snake	*Typhlops schinzi*	eastern sector	any habitat	present	Endemic, Secure

Common name	*Scientific name*	Distribution in Sperrgebiet	habitat	Occurrence	Conservation status
	Lamprophis fiskii	southern sector	not known	NYR	Not listed
Brown house snake	*Lamprophis fuliginosus*	throughout	any habitat	NYR	Secure
Spotted house snake	*Lamprophis guttatus*	eastern sector	rocky	NYR	Peripheral
Mole snake	*Pseudaspis cana*	throughout	any habitat	present	Secure
Dwarf beaked snake	*Dipsina multimaculata*	throughout	any habitat	NYR	Secure
Cross-marked sand snake	*Psammophis crucifer*	eastern sector	any habitat	NYR	Not listed
Namib sand snake	*Psammophis leightoni*	throughout	any habitat	NYR	Secure
Western sand snake	*Psammophis trigrammus*	eastern sector	any habitat	NYR	Secure
Whip snake	*Psammophis notostictus*	throughout	any habitat	NYR	Secure
Southern burrowing asp	*Atractaspis bibroni*	throughout	any habitat	NYR	Secure
Twin-striped shovel-snout	*Prosymna bivittata*	southern sector	not known	NYR	Secure
South-western shovel-snout	*Prosymna frontalis*	eastern & southern sector	rocky	NYR	Endemic, Secure
Spotted bush snake	*Philopthamnus semivariegatus*	eastern sector	rocky	NYR	Secure
Namib tiger snake	*Telescopus beetzi*	throughout	rocky	present	Secure
Damara tiger snake	*Telescopus semiannulatus*	eastern sector	any habitat	NYR	Secure
Egg-eater	*Dasypeltis scabra*	throughout	any habitat	NYR	Secure
Coral snake	*Aspidelaps lubricus*	throughout	any habitat	present	Secure
Black spitting cobra	*Nja nigricollis*	eastern sector	any habitat	present	Secure
Cape cobra	*Naja nivea*	throughout	any habitat	present	Secure
Horned adder	*Bitis caudalis*	throughout	any habitat	present	Secure
Namaqua dwarf adder	*Bitis schneideri*	throughout	sandy vegetated hummocks	NYR	Insufficiently known
Dwarf mountain adder	*Bitis xeropaga*	eastern sector	rocky	NYR	Endemic, Insufficiently known
Many horned adder	*Bitis cornuta*	throughout	any habitat	present	Secure
Puff adder	*Bitis arietans*	throughout	any habitat	present	Secure
Namib dwarf sand adder	*Bitis peringueyi*	eastern sector	sandy soil	present	Endemic, Secure
MAMMALS					
Shrews, golden mole, elephant shrews					
Reddish-grey musk shrew	*Crocidura cyanea*	eastern sector	any habitat	NYR	Secure
Namib golden mole	*Eremitalpa granti*	throughout	sandy soil	present	Secure
Short-eared elephant shrew	*Macroscelides proboscideus*	throughout	any habitat	NYR	Secure
Rock elephant shrew	*Elephantulus rupestris*	eastern sector	rocky	NYR	Secure
Bats					
Flat-headed free-tailed bat	*Sauromys petrophilus*	throughout	rocky	NYR	Secure
Little free-tailed bat	*Tadarida pumila*	eastern sector	any habitat	NYR	Secure
Egyptian free-tailed bat	*Tadarida aegyptiaca*	eastern sector	any habitat	NYR	Secure

Common name	***Scientific name***	**Distribution in Sperrgebiet**	**habitat**	**Occurrence**	**Conservation status**
Schreiber's long-fingered bat	*Miniopterus schreibersi*	eastern sector	requires caves	NYR	Secure
Angolan hairy bat	*Myotis seabrai*	throughout	not known	NYR	Endemic, Insufficiently known (Rare?)
Namib long-eared bat	*Laephotis namibensis*	eastern sector	not known	NYR	Endemic, Insufficiently known (Rare?)
Long-tailed serotine bat	*Eptesicus hottentotus*	eastern sector	mountainous	NYR	Secure
Melck's serotine bat	*Eptesicus melckorum*	southern sector	not known	NYR	Peripheral
Cape serotine bat	*Eptesicus capensis*	throughout	any habitat	present	Secure
Common slit-faced bat	*Nycteris thebaica*	throughout	any habitat	NYR	Secure
Ruppell's horseshoe bat	*Rhinolophus fumigatus*	throughout	requires caves	NYR	Secure
Darling's horseshoe bat	*Rhinolophus darlingi*	eastern sector	any habitat	NYR	Secure
Geoffroy's horseshoe bat	*Rhinolophus clivosus*	throughout	requires caves	NYR	Secure
Cape horseshoe bat	*Rhinolophus capensis*	southern sector	requires caves	NYR	Not listed
Dent's horseshoe bat	*Rhinolophus denti*	eastern sector	requires caves	NYR	Secure
Sundevall's leafnosed bat	*Hipposideros caffer*	throughout	requires caves	NYR	Secure
Primates, dassies, antbear					
Chacma baboon	*Papio ursinus*	eastern sector	mountains, free water	present	Secure
Rock dassie	*Procavia capensis*	throughout	rocky habitat	present	Secure
Antbear	*Orycteropus afer*	eastern sector	any habitat	NYR	Secure
Carnivores					
Aardwolf	*Proteles cristatus*	throughout	any habitat	present	Vulnerable
Brown hyena	*Hyaena brunnea*	throughout	any habitat	present	Vulnerable
Spotted hyena	*Hyaena crocuta*	eastern sector	any habitat, free water	present	Vulnerable
Cheetah	*Acinonyx jubatus*	eastern sector	any habitat	NYR	Vulnerable
Leopard	*Panthera pardus*	throughout	requires caves	present	Secure
Caracal	*Felis caracal*	throughout	any habitat	present	Secure
Wild cat	*Felis lybica*	throughout	any habitat	present	Vulnerable
Bat-eared fox	*Otocyon megalotis*	throughout	any habitat	present	Vulnerable
Cape fox	*Vulpes chama*	eastern sector	any habitat	present	Vulnerable
Black-backed jackal	*Canis mesomelas*	throughout	any habitat	present	Secure
Striped polecat	*Ictonyx striatus*	throughout	any habitat	present	Secure
Honey badger	*Mellivora capensis*	eastern sector	any habitat	present	Secure
Small-spotted genet	*Genetta genetta*	throughout	any habitat	present	Secure
Suricate	*Suricata suricatta*	central and eastern areas	any habitat	present	Secure
Yellow mongoose	*Cynictis penicillata*	central and eastern areas	any habitat	present	Secure
Slender mongoose	*Galerella sanguinea*	eastern sector	any habitat	present	Secure
Namaqua slender mongoose	*Galerella swalius*	eastern sector	not known	NYR	Endemic, Secure
Small grey mongoose	*Galerella pulverulenta*	eastern sector	any habitat	NYR	Indeterminate (Rare?)

Common name	***Scientific name***	**Distribution in Sperrgebiet**	**habitat**	**Occurrence**	**Conservation status**
Ruminants					
Hartmann's mountain zebra	*Equus zebra*	eastern sector	mountains, free water	NYR	Vulnerable
Common duiker	*Sulvicapra grimmia*	eastern sector	any habitat	NYR	Secure
Springbok	*Antidorcas marsupialis*	throughout	any habitat	present	Secure
Klipspringer	*Oreotragus oreotragus*	throughout	mountains	present	Secure
Steenbok	*Raphicerus campestris*	eastern sector	any habitat	present	Secure
Gemsbok	*Oryx gazella*	throughout	any habitat	present	Secure
Kudu	*Tregelaphus strepsiceros*	eastern sector	bush	NYR	Secure
Grey rhebok	*Pelea capreolus*	Schakalsberg	mountains	present	Protected game
Rodents, hares					
Namaque dune mole rat	*Bathyergus janetta*	southern and central areas	sandy soil	present	Secure
Porcupine	*Hystrix africaeaustralis*	throughout	any habitat	present	Secure
Springhare	*Pedetes capensis*	throughout	plains	present	Secure
Rock dormouse	*Graphiurus platyops*	eastern sector	rocky	NYR	Insufficiently known (Rare)
Ground squirrel	*Xerus inaurus*	eastern sector	any habitat	present	Secure
Mountain ground squirrel	*Xerus princeps*	eastern sector	plains and rocky habs	NYR	Endemic, Secure
Dassie rat	*Petromus typicus*	throughout	rocky	present	Endemic, Secure
Social whistling rat	*Parotomys brantsii*	southern sector	sand flats	present	Secure
Solitary whistling rat	*Parotomys littledalei*	eastern sector	sand flats, bush cover	present	Secure
Bush karoo rat	*Otomys unisulcatus*	eastern sector	rocky	NYR	Peripheral
Striped mouse	*Rhabdomys pumilio*	eastern sector	grass or bushes	NYR	Secure
Black-tailed tree rat	*Thallomys nigricauda*	eastern sector	trees	NYR	Secure
Namaqua rock rat	*Aethomys namaquensis*	throughout	any habitat	present	Secure
Short-tailed gerbil	*Desmodillus auricularis*	throughout	hard soil	present	Secure
Pygmy gerbil	*Gerbillurus paeba*	throughout	sandy soil	present	Secure
Namaqua brush-tailed gerbil	*Gerbillurus vallinus*	eastern sector	plains	NYR	Secure
Large-eared mouse	*Malacothrix typica*	throughout	hard soil	NYR	Secure
Nama rock mouse	*Petromyscus monticularis*	throughout	rocky	NYR	Endemic, Secure
Brukkaros rock mouse	*Petromyscus bruchus*	eastern sector	rocky	NYR	Secure
Namaqua rock mouse	*Petromuscus barbouri*	southern sector	rocky	NYR	Peripheral
Cape hare	*Lepus capensis*	throughout	plains with plant cover	present	Secure
Smith's red rock rabbit	*Pronolagus rupestris*	throughout	rocky	present	Secure