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**ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROPOSED AUAS – OTJIKOTO – LIFA 400 kV TRANSMISSION LINE**

# EXECUTIVE SUMMARY

CONTENTS

## PREFACE

This Executive Summary covers all three phases of the Environmental Study: -

- The Route Evaluation & Scoping Phase,
- The Environmental Assessment on the Final Route, and
- The Environmental Management Plan for all stages of the project cycle.

# 1. INTRODUCTION

## 1.1 The Project Proposal

### 1.1.1 Overview of the power line route

NamPower proposes to construct a 400kV power line from Windhoek to Ruacana as part of a wider plan to meet the need for growth in power supply in Namibia and the SADC Region.

The proposed route runs from Auas substation (east of Windhoek) and proceeds northwards to Gerus substation (west of Otjiwarongo), then to Otjikoto substation (near Tsumeb). From there to Oshivelo and then roughly north-westwards to Lifa (near Ruacana) where a new substation will be built. A link to the substation at Ongwediva is also planned.

The final route is 876km long, which is 7.4km shorter than the original route. It has 63 bend points, i.e. 25 more than the original route.

### 1.1.2 Description of the power line and related infrastructure

The power line will be designed to carry 400kV. The towers will be 40m high, and NamPower prefers the cross rope suspension tower design, which has two legs. In some circumstances, self-supporting suspension towers or straining towers are used, which have four legs and are used in conjunction with cross rope suspension towers.

A servitude of 55m wide is required, within which no buildings will be permitted but cultivation of crops and grazing of livestock can continue. The 55m includes a strip of 12 metres wide that will be cleared of trees and tall bushes - directly under the conductors. This is necessary to prevent flashovers caused by veld fires. An access track will be made, normally within the 12m cleared strip, to enable construction and maintenance of the line.

The first 150 km (approximately) northwards from Auas will be a double servitude (2 x 55m wide) to allow for a possible future line, although only one line will be constructed at this stage.

The construction of a 400kV power line costs approximately N$ 1 million per km (July 2004), therefore the line needs to follow the shortest route as far as possible.

## 1.2 Three Phases of the Environmental Study

The Environmental study was conducted in three phases.

### 1.2.1 Phase 1: Route Evaluation / Scoping

The first phase involved the following study components: -

- Mapping of the proposed and alternative routes at a scale of 1: 250 000,
- A helicopter flight over the proposed and alternative routes,
- Preliminary input from specialists (on birds, vegetation and archaeology),
- Public participation (including an advertisement, notices to Interested and Affected Parties, public meetings, correspondence, authority consultations),
- A Scoping Report, which was made available to the public and submitted to MET (DEA) for comment – and was approved by DEA.

It was found that two sections of the route were “fatally flawed” with regard to the impacts on birds. A high priority was therefore given to finding the lowest impact route, particularly with regard to birds north of Etosha, and near Otjiwarongo. Avoiding areas where large and endangered birds fly and feed is the best way to avoid impacts on vulnerable species.

### 1.2.2 Phase 2: Environmental Assessment (EA) on Final Route

- Mapping of the proposed and alternative routes at a scale of 1: 50 000 on orthophotos,
- A specialist report on birds,
- Field investigations on vegetation and archaeology, and a specialist report on each,
- Further public participation in the areas of Okahandja and Otjiwarongo (meetings and correspondence) to try to resolve some objections from owners of farms,
- Some adjustments to the route were made to avoid impacts on specific farms in cases where serious socio-economic impacts on specialised activities would have resulted,
- A helicopter flight over the Otjiwarongo area,
- Final mapping at a scale of 1: 50 000,
- An Environmental Assessment Report on the final power line route.

### 1.2.3 Phase 3: Environmental Management Plan (EMP)

An Environmental Management Plan has been drawn up, which details the management requirements for the: -

- Ground Survey and Design stage,
- Construction stage - Environmental Specifications will be included in Contracts,
- Operations and Maintenance stage (including Decommissioning).

# 2 DESCRIPTION OF THE PROJECT ENVIRONMENTS: FINAL ROUTE

## 2.1 Vegetation

The southern part of the route, **Auas to Otjikoto,** traverses almost entirely commercial farms, which are privately- or company-owned. These commercial farms are mainly used for rangelands, some hunting, and a few have tourist lodges.

The vegetation types are described in the EA Report. From south to north these are: -

- Highland savanna,
- Thornbush savanna, and
- Karstveld and Mountain Savanna,

From **Otjikoto to Oshivelo**, the route traverses commercial farms, then from **Oshivelo to Lifa**, the land tenure is almost entirely communal land.

The vegetation types traversed are: -

- Karstveld,
- Northern Kalahari,
- Cuvelai.

Further details of the vegetation types, particularly sensitive areas, and lists of protected species are provided in the EA report. Recommendations are made for stands of certain types of trees to be avoided as far as possible. Recommendations also include plant rescue operations in the case of certain types of plants, such as aloes, if impacts on these prove to be unavoidable. It was recommended that certain types of vegetation should be located and recorded during the ground survey, e.g. Aloes, so that they can either be avoided or relocated to a suitable, safe location.

## 2.2 Birds

The risk of collisions and electrocutions to many large species of birds was a major factor that influenced the selection of the power line route.

From Auas to Otjikoto, the main issue was a vulture conservation and feeding programme by the Rare & Endangered Species Trust (REST) on a farm to the northwest of Otjiwarongo. Minor adjustments to the route were also made to avoid ephemeral wetlands as far as possible.

Between Oshivelo and Lifa, the route was completely changed from that originally proposed by NamPower, as the original route was fatally flawed with regard to its impacts on a number of species of vulnerable and endangered species of large birds. The major flight path between Etosha Pans and Lake Oponono area and the saline grasslands that support many large walking species of birds were avoided. Instead, the line was moved northwards into areas that have low population densities and disturbed habitats, which are therefore much less attractive to large birds.

Recommendations for further mitigation are made in the EA report and EMP – to reduce those impacts that cannot be entirely avoided by route adjustments. For example bird flappers must be fitted in certain pre-specified types of situations.

## 2.3 Archaeological Sites

Areas most likely to yield archaeological findings were investigated in the field, but no significant archaeological sites were found. However recommendations are made in the EA and EMP for procedures to be followed if archaeological remains are discovered during the ground survey or construction stages. This is necessary in order to comply with the new National Heritage Act.

In the northern communal areas, all baobab trees and other large fruit trees, and wells are likely to yield archaeological remains and should therefore be avoided. These therefore need to be located during the ground survey and avoided in the final alignment.

## 2.4 Land Use and Related Socio-economic issues

On commercial farms every effort was made, through the public participation programme, to discover any activities that were incompatible with a power line. For example, a game capture and transit operation near Otjiwarongo requires the use of a helicopter to dart game while flying at tree-top height. On another farm there was a vulture feeding programme, mentioned above. Others had major tourist lodges. Wherever possible, an effort was made to avoid farms where the power line could have a significant adverse effect on the economic activities there.

In areas that are densely bush-encroached, a minor positive impact will result from the clearing of a 12m strip under the conductors. Clearing will open up the 12m corridor for grasses to grow which will improve grazing potential. In order to enhance this benefit, recommendations have been made for the use of herbicide on the re-growth of certain encroacher species.

Minor adverse impacts, mainly due to visual impacts, will still occur on many commercial farms which are used for hunting by foreigners who want to enjoy a "wilderness experience". This cannot be entirely avoided as there are so many farms where hunting is practised.

In the northern communal areas, there is low density settlement and dwellings and kraals are widely spaced for most of the route. Here further mitigation of socio-economic impacts is recommended by "fine-tuning" the alignment at the ground survey and design stage. This is needed to minimise the number of dwellings and kraals that need to be moved. Some will still need to be moved a hundred metres or so – and those owners will be compensated by NamPower. During the survey and design an effort will be made to minimise the impacts on cultivated lands, where the foundations of towers will each take up a few square metres. However the towers are spaced at intervals of about 550 metres, so there will be little impact on croplands.

The surveyor will be required to locate and record all baobabs, palm clumps and large fruit trees so that these can be avoided in the final alignment as far as possible.

Further recommendations have been made in the EA and EMP to mitigate potential impacts during the construction stage in particular, but also during the operations and maintenance stage.

## 3 SUMMARY OF IMPACTS & MITIGATION MEASURES: FINAL ROUTE

### 3.1 Mitigation of Impacts at the Ground Survey & Design Stage

While the route has been determined and mapped at a scale of 1: 50 000 the final alignment can only be designed in response to a ground survey which NamPower will commission soon after receiving this report. Thus "fine tuning" of the exact alignment is still possible at the survey / design stage.

| **Potential Env. Impact** | **Recommended Mitigation: Ground Survey & Design Stage** |
|---|---|
| **Impacts on Vegetation** | |
| Clearing of woody vegetation from the 12 m corridor: -<br>- Loss of stands of "special" trees such as Camelthorn, Leadwood, Tamboti<br>- Loss of important individual trees in the north (including baobabs, large fruit trees, palm clumps)<br>- Loss of Aloe colonies, succulents & geophytes[1] of conservation importance. | • Surveyor to record stands of "special" trees, aloe colonies, and indicate where these stands can be avoided in the final alignment if possible.<br>• Special attention in this regard to be given to: - rocky outcrops in the southern parts (Highland savanna), foothills of the karst areas, granite outcrops, any areas with many aloes, succulents, geophytes – which could be rescued and relocated.<br>• Surveyor to record all baobabs, large fruit trees (e.g. Marulas), and palm clumps within the proposed route corridor in communal areas in the north.<br>• Plant rescue operation by NBRI in the case of aloes, geophytes and succulents. |

[1] Geophytes are perennial plants that grow from an underground bulb or tuber

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| Loss of protected species (trees / other plants). | • Permit required for felling / removal. Application to be submitted after the final alignment is designed. |
| The positive impact from clearing in bush-encroached areas can be optimised. | • The construction tender should provide for poisoning of the re-growth of the main encroacher species with selective herbicide (e.g. *Dichrostachys cinerea* and *Acacia mellifera*). |
| **Impacts on Soils** | |
| Potential for soil erosion due to access tracks & vegetation clearing especially on<br>- steeper slopes,<br>- alluvial sediments,<br>- riverbanks where vegetation is removed or banks are steep. | • Surveyor to plan access tracks in the field and record best route.<br>• Design tracks to cross contours obliquely on steep slopes - not straight down slopes.<br>• Avoid alluvial sediments where possible in the design of access tracks.<br>• Cross rivers where the risk of erosion is least, and where the minimum of riverine trees has to be removed.<br>• No blading of the 12m corridor. Clear only tall woody vegetation and leave the ground cover of grass and small shrubs intact. (State this in the tender for construction).<br>• Allow for anti-erosion berms in tender for construction. |
| **Soil types and Founding conditions** | |
| In some areas, vertic clays (especially in the Karstveld) and saline (solonetz) soils (mainly areas north of Etosha in the Cuvelai basin) may present poor founding conditions. | • Geotechnical work to locate the presence of poor founding conditions.<br>• Mitigation would take the form of minor adjustments to the alignment and/or special design of foundations of the towers. |
| **Impacts on Birds (& Aircraft)** | |
| Collisions with power lines. | • In the vicinity of groups of vulture nests, try for alignment at least 500m away (e.g. Whitebacked vultures, especially in the Okahandja to Otjiwarongo area)<br>• Plan to fit bird flappers all sections of the line that are: -<br>- within 2km of vulture nests,<br>- within 500m of farm dams,<br>- within 500m of crossings of omirambas / rivers,<br>- within 500m of wetlands,<br>- within 2km of all landing strips.<br>• Configuration of the power line structures / conductors |
| Electrocution and short circuits when birds perch. | • Consider the use of modern designs that minimise the risks of electrocutions to perching birds. |
| **Impacts on Archaeological sites** | |
| Potential destruction / disturbance of sites, and infringement of the National Heritage Act. | • Surveyor to look out for and record position any evidence of archaeological sites. Particular attention should be given to: -<br>- Isolated outcrops in the area covered by map Sheets 1916 (Tsumeb) and 2016 (Otjiwarongo),<br>- Outcrops with copper oxide e.g. on Sheet 2216 (Windhoek),<br>- All baobab trees in the northern parts,<br>- All hand-dug wells in the northern parts.<br>• Report all findings and consult with J.Kinahan and NMC. |
| **Impacts of a Socio-economic type** | |
| Visual impacts | • There is little opportunity to further reduce visual impacts (this was considered at the route selection stage). However minor improvements may still be possible in the final alignment – particularly near homesteads, and game camps on hunting farms,<br>• Where the route runs close to existing power lines or roads, the final alignment should be as close as is permissible to existing infrastructure. |

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| Potential for health impacts from EMFs, although not proven. | • Consider a minimum of 100-300m from any dwellings, schools, and work stations as a precautionary measure. NamPower to decide on the minimum distance. |
| Dwellings and animal kraals may have to be moved in communal areas | • All dwellings & kraals within the 1000m corridor in the north should be recorded by the surveyor, then the best alignment selected to minimise the dwellings that need to be moved. |
| Cultivated fields on communal land may lose a little ground due to vehicle tracks and excavations. | • Cultivated lands should also be recorded by the surveyor, and taken into account in the design of the final alignment and positions of towers. |
| Adverse reactions may be encountered from community members. | • Public relations officer to accompany the ground surveyor.<br>• Surveyor to record dwellings, baobabs, clumps of palms, large fruit trees, cultivated lands etc. |
| Building houses (communal areas) in order to claim compensation. | • During the ground survey stage it will be essential for all houses within the 1000m corridor to be recorded, and, for the public relations person to explain to people that they will not be compensated for new houses built close to the line after the survey. |

### 3.2 Mitigation of Impacts at the Construction Stage

The following mitigation measures should be applied during construction of the power line.

| **Potential Env. Impact** | **Recommended Mitigation: Construction Stage** |
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| **Impacts on Vegetation** | |
| Unnecessary destruction of large trees, aloes, succulents & geophytes must be avoided (i.e. where they are outside the 12m corridor in the final alignment, they must not be damaged or removed. | • The Environmental Management Plan for construction includes specifications to be included in the contract.<br>• The Contractor and his site staff must be made aware of the requirements of the EMP and its Environmental Specifications.<br>• The Contractor & site staff must also be made aware of the sensitive areas: rocky outcrops, foothills of karst areas, granite outcrops. |
| Loss of timber trees | • Where felling of trees cannot be avoided, all timber and firewood must be made available to the land owner or community. |
| Eradication of encroacher species in the 12m corridor, stockpile areas etc. | • Maximise clearing of densely encroached areas – e.g. for stockpile areas and site camps.<br>• Use of selective herbicide on the re-growth of encroacher species. |
| **Impacts on Soils** | |
| Soil erosion caused by vehicle tracks. | • Particular care with regard to alignment of vehicle tracks, especially in steep areas, and alluvial soils. In steep areas tracks must cross contours at an acute angle and not perpendicularly.<br>• On alluvial soils and river banks the track must be created where the risk of erosion is minimised.<br>• A single track only shall be permitted. Multiple tracks must not be permitted. The Contractor must therefore maintain the tracks in a serviceable condition.<br>• Anti-erosion berms shall be constructed to lead water off the tracks wherever the risk of erosion exists due to gradients. |
| Soil erosion caused by removal of ground cover. | • Blading / removal of the ground cover of grasses and low shrubs must not be permitted.<br>• Only tall woody vegetation and trees shall be removed in the 12m corridor. |

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| **Impacts on Birds (& aircraft)** | |
| Collisions | • Fit bird flappers at certain locations according to design specifications. |
| **Impacts on Archaeological sites** | |
| Potential destruction of archaeological sites | • Report any evidence of archaeological sites turned up during construction.<br>• Stop the activity affecting the particular archaeological material and await further instructions.<br>• Be aware of likely sites: isolated koppies in the Tsumeb & Otjiwarongo areas, and copper oxide mineralization in the Windhoek-Okahandja areas.<br>• Avoid all baobabs and large fruit trees (e.g. no site camps etc)<br>• Avoid all hand-dug well (e.g. no disposal of waste or soil in or near hand-dug wells. |
| **Impacts of a Socio-economic type** | |
| Stock theft or poaching of wildlife | • All site staff shall be made aware that this will not be tolerated and that any guilty party will face suspension from the project as well as prosecution under the law. |
| Escape of stock or wildlife due to fences / gates left open. | • All site staff shall be instructed to ensure that fences / gates are closed and not left unattended while open. Furthermore, the land owner or kraal owner must be informed at all times. |
| Adverse reactions from local people | • Maintain good communications and relations with farm owners and local communities.<br>• In communal areas, work through the local authority structures.<br>• Respect people's property and privacy.<br>• No interference by construction personnel with the local people.<br>• Avoid unnecessary impacts on people's crop lands. |
| Loss of resources of construction wood and firewood | • Make wood available to locals where clearing of trees is unavoidable. |
| Noise | • Maintain vehicles and equipment (silencers etc) to prevent undue noise near dwellings, and schools and clinics – if applicable. |
| Litter & waste materials<br>- Visual impacts<br>- Plastic bags can cause fatalities<br>- Trapping birds or animals<br>- Glass bottles can cause fires. | • Provide bins for refuse at all work stations. Bins must be wind- and animal-proof.<br>• Remove all refuse and waste materials to an approved waste disposal site. |
| Veld fires caused by smoking, welding, cooking fires, glass bottles in the sun.<br><br>Veld fires can cause widespread damage – loss of grazing and destruction of woodlands. | • Make staff aware of fire risk and causes of veld fires.<br>• Emphasise fire risk to site staff again at dry times of the year.<br>• Allow welding and cooking fires only in designated situations.<br>• Have fire-fighting equipment, especially rubber beaters, at hand at all work stations at all times.<br>• Deploy staff to fight fires immediately if a fire starts. |

### 3.3 Mitigation of Impacts at the Operations & Maintenance Stage

| **Potential Env. Impact** | **Recommended Mitigation: Operations & Maintenance Stage (including Decommissioning)** |
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| **Impacts on Vegetation** | |
| Optimise the benefits of clearing the 12m corridor. | • Maintain the 12m corridor clear of encroacher species such as Sekelbos and Swarthaak. |

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| **Impacts on Soils** | |
| Erosion of access tracks | • Maintain tracks to prevent erosion by constructing anti-erosion berms, gravelling on soft sandy substrates etc as required.<br>• No blading to remove groundcover such as grasses. |
| **Impacts on Birds** | |
| Monitor bird impacts by encouraging local people to report any fatalities to birds. | • In the event of significant numbers of collisions, extra bird flappers may be required at specific locations.<br>• In the event of perching or nesting birds being electrocuted, devices may need to be added to the towers on a needs basis. |
| **Impacts on Archaeological sites** | |
| Particularly in the case of baobabs and other large trees and wells, impacts may occur during maintenance operations. | • The same measures would apply as at the construction stage – i.e. not setting up camps under baobabs, and avoiding the use of hand-dug wells for waste disposal. |
| **Impacts of a Socio-economic type** | |
| Electromagnetic fields | • Prevent the development of dwellings and schools within 100m of the power line. |
| Stock theft or poaching of wildlife | • Strict management of all site staff.<br>• Advance communication with farm owners / occupants when their farm will be accessed. |
| Escape of stock or wildlife due to gates left open. | • Strict management of all site staff.<br>• Advance communication with farm owners / occupants when their farm will be accessed. |
| Adverse reactions from local people | • Maintain good communications and relations with farm owners and local communities.<br>• In communal areas, work through the local authority structures.<br>• Respect people's property and privacy.<br>• No interference by construction personnel with the local people.<br>• Avoid unnecessary impacts on people's crop lands. |
| Maintenance of the 12m corridor free of tall woody plants. | • Make wood / firewood available to locals |
| Litter & waste materials<br>- Visual impacts<br>- Plastic bags can cause fatalities<br>- Trapping birds or animals<br>- Glass bottles can cause fires. | • Provide bins for refuse at all work stations. Bins must be wind- and animal-proof.<br>• Remove all refuse and waste materials to an approved waste disposal site. |
| Veld fires caused by smoking, welding, cooking fires, glass bottles in the sun.<br><br>Veld fires can cause widespread damage – loss of grazing and destruction of woodlands. | • Make staff aware of fire risk and causes of veld fires.<br>• Emphasise fire risk to site staff again at dry times of the year.<br>• Allow welding and cooking fires only in designated situations.<br>• Have fire-fighting equipment, especially rubber beaters, at hand at all work stations at all times.<br>• Deploy staff to fight fires immediately if a fire starts. |
| **Decommissioning stage** | |
| • All the relevant requirements for the operations and maintenance stage should also be implemented at the decommissioning stage. | |
| • In addition, consideration should also be given to (a) re-use of steel from the towers, or (b) recycling of these materials. | |

## 4 CONCLUSION

The Environmental Assessment of the proposed power line from Auas- Otjikoto – Lifa has involved an extensive process of public consultation, specialist study, and field studies. The most important environmental impacts, both bio-physical and socio-economic have been avoided as far as possible through the route selection process.

Two sections of the original proposed route were found to be fatally flawed with regard to large bird species – north of Etosha, and near Otjiwarongo. This necessitated some significant changes to the route at the Scoping stage of the study.

Further minor changes were made to the route during the Environmental Assessment to avoid specific socio-economic problems relating to specialised land uses on certain commercial farms, mainly in the Otjiwarongo area.

The EA Report was then prepared for the final route. Further recommendations have been made, for mitigation of the remaining impacts, in the EA and Environmental Management Plan.

A literature review was conducted on the subject of potential health impacts of electromagnetic fields (EMFs) and a chapter in the EA devoted to this subject. Although there is no conclusive evidence of impacts on human or animal health at this stage, the literature suggests that a precautionary approach should be adopted with regard to “safe” distances from high voltage power lines. NamPower should consider imposing a minimum of 100 – 300m from all dwellings, schools and places of work (i.e. where people are spending long hours almost every day). Greater distances may be needed from substations.

The EMP deals with mitigation at each stage: -

- survey and design,
- construction, and
- operations and maintenance (including decommissioning).

At the survey stage, a number of things need to be located and recorded and then taken into account in designing the final alignment. For example: -

- all existing dwellings, kraals and cultivated lands,
- stands of protected species of trees,
- individual large trees in the north e.g. baobabs and marulas,
- colonies of aloes and other succulents,
- soils that are poor for founding conditions.

At the design stage, an effort needs to be made to minimise the remaining impacts in the final alignment. In regard to plants, arrangements should be made with the NBRI for a plant rescue operation if necessary for species such as aloes, succulents and bulbs. This would need to be done during the rainy season.

A set of Environmental Specifications is contained in the EMP. It is recommended that these should be included in the construction tender and contract so that they can be enforced on site. The EMP also includes a recommendation for construction monitoring by an independent Environmental Control Officer – in addition to enforcement of the Environmental Specifications by the Site Engineer on a daily basis.

In conclusion, the impacts of the project have been well considered. Primary mitigation was achieved by changes to the route, while recommendations for further mitigation have been made for each stage of the project cycle, from survey and design, through construction to operations and maintenance.

It is recommended that the project should be approved for the Final Route that is detailed in the EA Report. Such approval should be made conditional on the effective implementation of the recommendations for further mitigation wherever practical. In this regard, the survey and design stage will be as important as the construction stage.