

**ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROPOSED
GERUS – MURURANI GATE 350 kV TRANSMISSION LINE**

**VOLUME 3:
ENVIRONMENTAL MANAGEMENT PLAN
FINAL REPORT**

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LIST OF ABBREVIATIONS

EA	Environmental Assessment (also known as an Environmental Impact Assessment)
EMF	Electromagnetic Field
EMP	Environmental Management Plan
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
I&APs	Interested & Affected Parties (stakeholders)
kV	Kilovolts (1 kilovolt = 1000 volts)
MET	Ministry of Environment and Tourism
PPP	Public Participation Process (a component of the EA study)

1 INTRODUCTION

Namibia faces a potential power shortage by the year 2007. The hydro power station at Ruacana generates about half of Namibia's power, while the rest is currently imported from South Africa. The growing demand in South Africa is expected to use up their surplus power generation capacity by 2007. As a result of the future shortage in power supply, Namibia is looking to alternative power sources.

Various alternatives have been assessed in order to address the future power supply shortage. It is expected that the proposed Kudu Gas power station at Oranjemund will be operational around 2009. Kudu Gas will supply sufficient power for Namibia's needs for 20 years or more with spare capacity to export some of its power. The Kudu Gas power station will be suitable for generating the base load requirements, while Ruacana (like most hydro power stations) is able to vary its power output rapidly and is therefore very suitable to supply peak demand periods (e.g. early evening is a peak demand period).

NamPower are currently expanding their national electricity transmission grid in an attempt to provide for future power generation and transmission requirements, which forms part of the greater plan to meet the need for growth in power demand and supply in Namibia and the greater SADC Region.

The power line will form part of a larger transmission route which will run from Auas Sub-Station (near Windhoek) via Gerus Sub-Station (north of Otjiwarongo) to Mururani Gate to Rundu to Katima Mulilo. The EA for the overall transmission line has been conducted in three phases and within each phase a separate Environmental Assessment (EA) is being/has been conducted. The EA's have been conducted as follows:

- Phase 1: Auas – Otjikoto – Lifa 400kV Transmission Line
- Phase 2: Gerus - Mururani Gate 350kV Transmission Line
- Phase 3: Otjikoto - Katima Mulilo 350kV Transmission Line.

The proposed Gerus-Mururani Gate Power line is situated in the Otjozondjupa Region in Namibia. The route starts at Gerus Transmission sub station (north of Otjiwarongo) from there the line runs through the Otjozondjupa Region in a north-easterly direction, where the line ties in with the existing line at Mururani Gate.

The Environmental Assessment process undertaken for this process consisted of 3 phases:

- Scoping Phase;
- Environmental Assessment; and
- Environmental Management Plan.

The Scoping Phase or Volume 1 Route Evaluation and Scoping Report considered the need for the power line and contained details of the proposed and alternative routes and technology. An account of the public participation process was given and the issues and concerns that were raised by interested and affected parties (I&AP's) were included.

The EA Report (Volume 2, Eco.plan 2006) has included continued public consultation, detailed specialist studies and field studies. The most important environmental impacts, both bio-physical and socio-economic were avoided as far as possible through the route selection process during the Scoping Phase. The EA Report considered the environmental impacts, both bio-physical and socio-economic, of the route, and has provided extensive mitigation and management measures to address these impacts. Mitigation and management measures have been made for various stages of the power line project cycle, i.e. survey & design, construction and operation.

The Environmental Management Plan, Volume 3, arises out of Phase 2, which identified a number of potential environmental impacts that need to be managed during the three important stages of the project cycle:

- Ground Survey & Design stage;
- Construction stage; and
- Operation & Maintenance stage.

Many of the key impacts of the project were addressed through the route selection process – working at a scale of 1: 50,000. Remaining impacts that could not be addressed through route selection still need to be addressed during the above-mentioned three phases. The purpose of this EMP is to provide guidelines to NamPower for the first and third stages and Environmental Specifications for the second stage - Construction.

For each stage mentioned above, this EMP also outlines the roles and responsibilities of all parties who can influence or give effect to the recommendations or specifications that follow.

The EA report included a description of the affected environments, and the activities that can give rise to negative impacts. It is important that all parties should understand the guidelines / specifications, and the reasons for them. This EMP should therefore be read in conjunction with the Environmental Assessment (Volume 2) in order to understand the nature of the affected environments and the manner in which it could be affected.

It is understood that for the survey/design stage and the operations/maintenance stage, NamPower will undertake the work themselves (“in-house”). However a tender will be offered for the construction stage. Chapter 2 therefore takes the form of a set of Environmental Specifications that can be included in Contract Documents and enforced on site during Construction.

2 REQUIREMENTS FOR ENVIRONMENTAL MANAGEMENT: SURVEY & DESIGN STAGE

2.1 Roles and Responsibilities for Environmental Management: Survey & Design

2.1.1 NamPower (including Project Manager, Surveyor, Designer, Public Relations Officer)

NamPower, as the proponent and “owner” of the project carries the ultimate responsibility for all stages of the project and the environmental impacts resulting from it.

At the Ground Survey & Design stage it is understood that NamPower will fulfill the roles of Project Manager, Surveyor, and Design Engineers. The EA also recommended that a Public Relations officer should accompany the surveyor in the field to explain and negotiate with affected farmers and land owners. Those who fulfill these three roles have the opportunity and responsibility to manage the following environmental aspects: -

- During the EA, the detail provided was limited by the accuracy, age, and resolution of the available orthophotos as well as limited access on the ground during the fieldwork. The ground survey, undertaken by NamPower, will therefore need to be aware of the issues identified in the EA and give attention to locating and recording sensitive sites such as dwellings, individual large trees, stands of protected trees, sensitive ornithological areas etc.;
- The engineering designers should use the surveyed environmental data to influence the precise alignment (or adjustment) of the power line and access tracks, and precise placement of towers. Consideration should also be given to using modern configurations of towers and conductors which have been shown to reduce the risks to large birds; and
- The project manager needs to ensure that the individual personnel that fulfil above-mentioned roles are fully briefed and understand their responsibilities with regard to the environmental issues which they can influence. This is particularly important as the responsible personnel such as surveyors, engineers, and public relations staff do not always have prior experience with environmental matters. They need to understand how and why they must contribute to giving effect to the environmental recommendations. The Environmental Consultant should be called on to assist in briefing the Surveyor, Design Engineers, and Tenderers for the Construction Contract.

2.1.2 Environmental Consultant

- The Environmental consultants have conducted the EA (Eco.plan October 2006) and drawn up this EMP; and
- The Environmental consultant should assist the Project Manager in briefing the various role players mentioned in Section 2.1.1 above. It will be particularly important that the surveyor and design team understand the environmental issues before they begin their work. Induction for these roleplayers is therefore recommended.

2.1.3 Communication Between Parties

- At all stages of the project cycle, open communication between all role players is important to ensure that proper environmental management is carried out; and
- In this way a pro-active approach can be adopted whereby unnecessary environmental impacts can be avoided, and unavoidable impacts can often be minimised.

2.2 **General**

During the Environmental Assessment, the route was mapped at a scale of 1: 50,000 (Volume 2). At that scale details of vegetation, topography, and even small dwellings can sometimes be overlooked. Therefore more detailed information is required from the ground survey. This information must then be used to “fine tune” and adjust the alignment at the design stage of the power line.

Sections 2.3 – 2.7 below will provide further details on information that needs to be gathered or confirmed during the ground survey and taken into account in designing the final alignment.

2.3 **Vegetation**

2.3.1 Minimising impacts on protected trees (and other large specimens)

Clearing a 12m strip of woody vegetation may destroy many trees. Of particular concern are species that are protected by law. Appendix A lists the protected species likely to be encountered for each habitat along the route. In the case of some species, individual specimens are usually widespread and scattered. In such cases it will be difficult to design the final alignment to take these trees into account. However, other species e.g. Tamboti, Camelthorn, and Leadwood, often occur in stands of many trees. Where such stands occur on or close to the route they should be located and recorded by the surveyor and avoided in the final alignment as far as possible. Where avoidance is not possible, the least-impact alignment should be designed.

For scattered individual trees, it will only be practical to locate and record the larger, more impressive specimens.

A certain amount of discretion will therefore need to be exercised by the surveyor in determining what is practical to record.

2.3.2 Minimising impacts on other protected plants

In the case of other protected plants, a similar approach must be taken as for trees during the ground survey and design stage. Where these cannot be avoided, a plant rescue operation is required.

2.3.3 Plant rescue

At the design stage, a plant rescue operation must be organised with the National Botanical Research Institute (NBRI Tel. 061 - 2022023)

2.3.4 Permits

Where protected species of trees and other plants cannot be avoided, permits must be obtained at the design stage.

A permit is required from the Directorate of Forestry (MAWF) to remove any protected trees. (Tel. 061 – 221478, 221511 or 221671)

For other protected plants, e.g. aloes, succulents, bulbs, a permit is required from the Ministry of Environment and Tourism. Contact the Permit Office at MET (Tel. 061 – 263131).

2.3.5 Particularly sensitive areas for plants

The following areas are likely to be particularly sensitive for vegetation, especially protected species, but they will not be limited to these areas. For more detail refer to Volume 2, Section 6.1.

- The Thornbush savanna where care should be taken to destroy as little as possible of the big trees found, especially the protected species *Acacia erioloba* and *A. tortilis*. Here big trees like *Sclerocarya birrea*, *Spyrostachys africana* and *Kirkia accuminata* are endangered;
- The Karstveld Plains. Little is known about the composition of the herbaceous layer of the Karstveld Plains, it is however expected to show a high diversity of species. For this reason, the Karstveld plains were also identified as an “Important Plant Area” worthy of further investigation and protection (Hofmeyr 2004); and
- The Omuramba Ovambo, also known as the “Parkiesveld”. The understory and herb layers are diverse as a variety of rare forbs species, stem succulents and geophytes has been observed here.

2.3.6 Optimising the clearing of bush-encroached areas

- In areas that are densely encoached by *Acacia mellifera* (Swarthaak) and *Dichrostachys cinerea* (Sekelbos), provision must be made in the Tender documents for follow-up spraying of the re-growth with selective herbicide (refer to Section 3.3.3 below); and

- The final alignment should optimise the clearing of densely encroached areas of these two species, e.g. areas for site camps and stockpiles should be located where dense stands of these species exist in order to optimise the benefits of clearing in bush-encroached areas. The land owners should be consulted in this regard.

2.3.7 Control of alien invasive plants

According to the International Union for Nature Conservation (IUCN) alien invasive plants have become as great a threat to biodiversity worldwide, as development. In other words, invasive alien plants are the cause of as many species extinctions as development. Namibia has been protected to some extent by the low population and low levels of development. So far alien plants have not caused any extensive destruction of habitats in Namibia. However the growth and spread of these pest plants is exponential. This means that, if the problem is not addressed at the early stages it will become out of control – as in many parts of South Africa and East Africa.

- It is essential that provision be made for the control and elimination of alien invasive species from the planning stage (by allowing a budget for this) through the construction and operations stages; and
- A useful reference book is Problem Plants of South Africa (Bromilow, 2001).

A list of alien plant species is include in Appendix B.

2.4 Soils

2.4.1 Management of soil erosion

The potential for soil erosion exists mainly as a result of access tracks & vegetation clearing.

The following mitigation measures are recommended at the survey and design stage: -

- Surveyor to plan access tracks in the field and record optimum route;
- Design tracks to cross contours obliquely on steep slopes (not straight down slopes);
- No blading should be undertaken on / in 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); and
- Allow for anti-erosion measures in schedule of quantities in the tender for construction.

2.5 Aviation Hazards

The power line in the vicinity of landing strips is an obvious hazard to aircraft. During the EA, a few landing strips were noted and avoided in the route design. However, some private landing strips may have not come to light during the public participation:

- Therefore the surveyor should ask all farm owners / occupants and locate any landing strips that are in use;
- These may need to be taken into account in the final alignment. The power line should not be closer than 2km from the end of a landing strip in the flight-path direction;
- Aircraft spheres must be installed on any part of the power line within 2km of any landing strip to make it visible to aircraft; and
- Aircraft spheres must also be installed wherever the power line crosses a major road – in case of emergency landings on roads.

2.6 Birds

Power lines are a hazard to large birds, refer to Appendix C for a list of important bird species that will be affected. Water will also attract many large birds to drink or feed. Large birds will be particularly vulnerable near farm dams, pans and perennial rivers.

Away from the large perennial rivers, other species of birds are likely to be affected, particularly near farm dams or pans (whether permanent or ephemeral). Vulture and other large birds will be at risk as they fly down to drink and bathe. Where ever large raptors nest, the raptors and their young will also be at risk.

The following is therefore recommended:

- At the survey and design stage, vulture's and eagle's nests near the power line route must be located and recorded;
- Where practically possible, the final alignment should be at least 500m away from groups of vulture nests and nests of other large raptors such as eagles;
- Provision should be made to fit bird flappers on all sections of the line that are: -
 - within 2km of nests of large raptors such as vultures and eagles
 - within 500m from farm dams
 - within 500m from crossings of ephemeral omarambas
- Routing through, and destruction of sensitive vegetation species should be avoided as there provide a habitat for birds;
- Hills, cultivated areas, drainage lines and wetlands should be avoided; and
- Planning for construction phase should take breeding of sensitive bird species into account.

2.7 Archaeological Sites

Although no significant archaeological finds were made during the EA, the possibility exists that these could be turned up at the survey or construction stages. In particular, the area of outcropping Etjo (now Twyfelfontein) Formation sandstones should be avoided. Archaeological sites are protected under the National Heritage Act (2004) which requires that any archaeological sites be reported. Therefore: -

- The surveyor must look out for and record the location of any obvious archaeological sites / material. In this regard, particular attention should be given to:
 - Isolated outcrops in the area of Otjiwarongo
 - All baobab trees in the northern parts
 - All hand-dug wells in the northern parts
- Any findings must be reported to the Heritage council and J.Kinahan (Tel. 061 – 256702 / 236216) should be consulted for advice.

2.8 Complaints and Environmental Incidents Register

It is important to ensure the responsible handling and recording of complaints received from the community and the correct recording of incidents occurring on-site. The following must be undertaken:

- Complaints received from the community must be registered and recorded by the Environmental Manager. The complaints must be brought to the attention of the Environmental Control Officer (ECO) and Contractor, who will respond accordingly. The following information must be recorded:
 - Time, date and nature of complaint
 - Response and investigation undertaken

- Actions taken and by whom
- All complaints will be investigated and a formal response is to be given within 14 days of receipt;
- Environmental incidents occurring on site must be recorded. The following information must be provided;
 - Time, date, location and nature of the incident; and
 - Actions taken and by whom

An example of the ECO Report Format is included in Appendix D.

2.9 Socio-Economic Issues

- Visual impacts are often offensive to farm owners. There is little opportunity to further reduce visual impacts (this was considered at the route selection stage). However it may still be possible to make minor improvements in the final alignment – particularly in relation to homesteads and game camps on hunting farms. Possible opportunities for minor re-alignments may exist for using trees or topographical features as a visual screen. The surveyor should be alert for such situations in places that are sensitive to visual impacts, e.g. near homesteads on commercial farms;
- Where the route runs close to existing power lines or roads, the final alignment should be as close as is permissible to existing infrastructure. Therefore, the edge of road reserves, existing power lines and other infrastructure will need to be recorded by the surveyor, and taken into account in the final alignment;
- Although there is no conclusive evidence of health impacts caused by power lines, a minimum distance of 100m to 300m from any dwellings, schools, and work stations is recommended based on the Precautionary Principle;
- Dwellings and animal kraals may have to be moved in communal areas. Therefore all dwellings & kraals within the 500m corridor in the north should be recorded by the surveyor. Then the best alignment should be selected to minimise the number of dwellings that need to be moved;
- Similarly, cultivated fields on communal land need to be located within the 500m corridor. These should be avoided as far as possible in the design of tower positions and access tracks. Where avoidance is not possible the survey information may be needed for the purposes of resolving issues of compensation to subsistence farmers; and
- Adverse reactions may be encountered from community members. It is therefore recommended that a Public Relations Officer (PRO) from NamPower should accompany the surveyor. The PRO must consult with the affected community members, starting with the relevant headmen / local authority structures. The PRO must explain and discuss the following with all affected community members: -
 - The way in which the planning process was conducted
 - The reasons for the location of the route
 - The reasons why local people cannot be supplied from this transmission line, (due to the need for expensive transformers)
 - The hazards of tampering with structures / towers

- Possible employment opportunities during construction (Care should be taken not to raise false expectations in this regard).

3 ENVIRONMENTAL SPECIFICATIONS: CONSTRUCTION STAGE

3.1 Roles and Responsibilities for Environmental Management: Construction Stage

3.1.1 NamPower

NamPower carries the ultimate responsibility for all stages of the project and the environmental impacts resulting from it. NamPower's Project Manager must ensure that: -

- The EMP and its Environmental Specifications are included in Contract documents and that the Contractor, and all his Subcontractors are able to carry out the requirements of the EMP;
- The Site Engineer monitors and enforces compliance with the Environmental Specifications on a day-to-day basis;
- During construction periodic Environmental Audits must be conducted by a suitably qualified Environmental Control Officer to confirm that the environmental requirements are being properly understood and effectively implemented;
- Sufficient budget is provided for the contractor to implement those measures that have cost implications (e.g. anti-erosion measures) where required. To this end, the relevant Environmental Specifications should be listed in the schedule of Quantities in the Tender Document; and
- Open and effective communication is maintained between all parties who can influence the environmental management on the project.

3.1.2 Site Engineer

- Be familiar with the contents of the Environmental Assessment and this Environmental Management Plan and the reasons for the measures that are recommended therein;
- Monitor the Contractor's compliance with the Environmental Specifications on a daily basis and enforce the Environmental Specifications on site;
- Communicate to the Contractor the advice of the Environmental Control Officer (ECO);
- Undertake costing of measures recommended by the ECO before issuing site instructions giving effect thereto;
- Communicate to the ECO timeously in advance any proposed project actions which may have negative impacts on the environment (e.g opening of new borrow pits);
- In the event of any infringements leading to environmental damage, consult with the ECO and seek advice on any remedial measures that could be employed to limit or rectify the damage;
- Maintain a record (photographic and written) of "before-and-after" conditions on site;
- Facilitate communication between all role players in the interests of effective Environmental Management;
- Review the exact routes of all temporary access tracks on site, adjust the alignment if necessary, and advise the Contractor accordingly;

3.1.3 Environmental Control Officer (ECO)

A suitably qualified Environmental Control Officer must take responsibility to: -

- Undertake periodic Environmental Audits of the Contractors performance in relation to the Environmental Specifications;
- ECO audits should be carried out monthly during construction;
- Submit a report on each site inspection to the Site Engineer and Project Manager (refer to report format in Appendix E);
- Advise the Site Engineer and Project Manager on any matters of interpretation and implementation of the Environmental Specifications as required;
- Make recommendations for remedial action in cases of non-compliance with the Environmental Specifications; and
- Advice concerning rehabilitation measures as required.

3.1.4 Contractor

The Contractor shall have the responsibility to: -

- Be familiar with the contents of the Environmental Assessment report and this Environmental Management Plan;
- Comply with the Environmental Specifications contained in this EMP;
- Demarcate the permissible working area in sensitive areas (e.g. stands of protected trees that must not be damaged or removed) and maintain such restrictions throughout the duration of the works in that area in order to limit the extent of environmental impacts;
- Notify the ECO through the Site Engineer immediately in the event of any accidental infringements of the specifications so that appropriate remedial action can be taken;
- Notify the ECO through the Construction Supervisor timeously in advance of any actions he has reason to believe will have significant negative impacts, so that mitigatory measures can be discussed and implemented before negative impacts arise;
- Conduct environmental education amongst his employees and sub-contractors so that they are fully aware of the Environmental Specifications and the reasons for them. The ECO is available to assist, on request, but it remains the responsibility of the Contractor to ensure that employees have the necessary knowledge to comply with the specifications. Most of the educational information required is contained in the EA Report and EMP; and
- Undertake rehabilitation measures where required by the Site Engineer in consultation with the ECO. Rehabilitation measures must be carried out progressively and not left till the end of the project.

3.1.5 Communication Between Parties

The importance of open communication between all parties is emphasised, as the attainment of environmental quality requires a joint effort. Only with open communication can a proactive approach be

achieved. This approach should ensure that environmental impacts are anticipated and prevented, or minimised, rather than a negative “policing” approach after negative impacts have already occurred.

3.2 Environmental Specifications: General

3.2.1 Presentation of the Environmental Specifications in this Section 3.2

The headings in this Section 3.2 are for ease of reference only and do not form part of the specification. Some of the specifications are prefaced with explanatory notes in italic type. The text in italics is intended to explain the reasons for the specification and must be understood by all construction personnel and transport personnel on site.

3.2.2 Compliance with the Environmental Specifications

The Contract shall be conducted in an environmentally and socially responsible manner. The Contractor shall comply with the Environmental Specifications contained in this section (Section 3.2).

3.2.3 Payment for compliance with the Environmental Specifications

No separate payment will be made for compliance with the Environmental Specifications unless specifically detailed in the Schedule of Quantities. Therefore the Contractor's rates shall be fully inclusive of all costs incurred in complying with these specifications.

Should any conflict arise between the Environmental Specifications and any other specifications contained in the Contract Documents, the Environmental Specifications shall prevail.

3.2.4 Training of construction personnel

Training is important, not only to ensure compliance with the Environmental Specifications, but also to increase the environmental awareness and knowledge amongst the construction staff.

The Contractor shall be responsible for conducting Environmental Training amongst all construction related personnel including employees, sub-consultants, transport drivers and plant operators to ensure that they have the necessary knowledge to comply with the Environmental Specifications. All relevant parties shall be required to comply with the Environmental Specifications.

3.2.5 Location of site camps

Site camps shall be located where they will have a minimum impact on indigenous vegetation especially large trees and any protected species. However, an exception applies in the case of densely bush-encroached areas dominated by *Acacia mellifera* (Swarthaak) and/or *Dichrostachys cinerea* (Sekelbos) where clearing of these encroached areas should be optimised.

Site camps shall not be located within 100m from any water body whether permanent or ephemeral including rivers, pans, wetlands, dams, and oshanas. The location of a site camp requires prior approval from the Engineer, and the land owner or local headman in the case of communal land.

3.2.6 Maintenance and rehabilitation of site camps

Site camps are often sources of litter and / or pollution.

Site camps and surrounds shall be maintained in a clean orderly and presentable condition at all times. Waste water from kitchen and ablution facilities shall be led to soak pits away from any rivers, pans, wetlands, dams, and oshanas.

After completion of the works the Contractor shall restore the area of the site camp and stockpile areas to its former condition. All waste, rubble and foundations shall be removed from site. Any compacted ground shall be ripped to loosen soil. The only exceptions in this regard are (a) in the case where encroacher species of bush were removed as detailed in Section 3.3.3 below, and (b) if the site camp is left by arrangement with the landowner for their use.

3.2.7 Fuel, oils and other toxic substances

Tanks for fuels oils etc. shall be bunded in a manner adequate to contain any possible spills. Drip trays shall be used under all hydrocarbon dispensing mechanisms. Toxic substances shall not be permitted to soak into the ground.

3.2.8 Restricted working area

In order to minimise the area disturbed and thus minimise the need for costly rehabilitation, the working area shall be restricted, particularly in relation to vehicle movement.

The Contractor shall restrict movement of people and vehicles to the absolute minimum that is required to complete the work. He shall demarcate the permissible working areas at the start of construction in each area. All site personnel shall be instructed to stay within the bounds of these demarcated working areas.

3.2.9 Work Stoppage

The Engineer shall have the right to order work to be stopped in the event of infringements of the Environmental Specifications resulting in significant and unnecessary environmental damage until the situation is rectified and brought to a state of compliance. In the event of such work stoppage the Contractor shall not be entitled to claim for delays.

3.3 Environmental Specifications: Vegetation and Soils

3.3.1 Conservation of indigenous vegetation

The project requires that a 12m will be cleared of woody vegetation under the power line prior to construction. No blading will be undertaken. This, together with areas required for stockpiles and site camps, represents the only areas that may be cleared.

Every effort shall be made to avoid disturbance to, or removal of indigenous vegetation except where clearing is required under the Contract. (The only exception is densely bush-encroached areas of *Acacia mellifera* and *Dichrostachys cinerea*, as mentioned in Section 3.3.3 below, where clearing should be optimised.)

No trees shall be felled and no vegetation cleared without the prior approval of the Engineer. The Contractor shall be aware of the arrangement for plant rescue operations by the NBRI, and no aloes or succulents shall be removed or destroyed by the Contractor.

3.3.2 Particularly sensitive areas of vegetation

The following areas are likely to be particularly sensitive for vegetation, especially protected species, and the Contractor shall be particularly careful to minimise impacts on vegetation in sensitive areas such as: -

- The Thornbush savanna where care should be taken to destroy as little as possible of the big trees found, especially the protected species *Acacia erioloba* and *A. tortilis*. Here big trees like *Sclerocarya birrea*, *Spyrostachys africana* and *Kirkia accuminata* are endangered;
- The Karstveld Plains. Little is known about the composition of the herbaceous layer of the Karstveld Plains, it is however expected to show a high diversity of species. For this reason, the Karstveld plains were also identified as an “Important Plant Area” worthy of further investigation and protection (Hofmeyr 2004); and
- The Omuramba Ovambo, also known as the “Parkiesveld”. The understory and herb layers are diverse as a variety of rare forbs species, stem succulents and geophytes has been observed here.

3.3.3 Bush encroached areas

The project presents an opportunity to make a small contribution to the problem of bush encroachment. This opportunity should be optimised by clearing densely encroached areas which are dominated by certain encroacher species in preference to areas that are dominated by grasses, broad-leaved trees or other non-encroacher species.

In areas of dense bush encroachment consisting of *Acacia mellifera* (Swarthaak) and/or *Dichrostachys cinerea* (Sekelbos) site camps and stockpile areas shall be made in encroached areas rather than non-encroached areas which are relatively free of the aforementioned species.

Following construction, the re-growth of the aforementioned species shall be sprayed with a selective herbicide. This shall be carried out at an appropriate time of year when the young plants are growing vigorously but before they flower and set seed.

3.3.4 Blading

Disturbance of the ground cover or topsoil exposes the soil unnecessarily to the risk of erosion. The ground shall not be bladed, thus grasses and low herbaceous plant cover shall be left in place.

3.3.5 Conservation of the topsoil or seed layer

The top layer of the soil which contains some organic matter and seed is extremely important for the natural regeneration of vegetation. This topsoil or "seed layer" must therefore be conserved regardless of whether a distinct "A-horizon" is visible or not, or whether the top layer is stony or not.

The topsoil shall be deemed to be the top 150mm. Topsoil shall be excavated from the following areas at the start of construction in each locality and shall be stockpiled separately for later replacement wherever it is needed: -

- All areas to be excavated e.g. for the foundations of towers;
- Areas used for batching of concrete; and
- Areas used for storage of fuels and oils.

The topsoil shall not be mixed or contaminated with any other material. Subsoil shall be stockpiled separately. Erosion of stockpiles of topsoil shall be prevented. On completion, the topsoil shall be spread around the site of the works, particularly in places where severe disturbance of the soil has occurred.

In any areas where the soil has been compacted, e.g. at site camps, storage areas, turning or bays for vehicles, the topsoil shall be ripped to a depth of 150mm. Where stockpiles of topsoil are available from excavations these shall then be spread on top.

3.3.6 Erosion Control

Construction activities have the potential to cause soil erosion, particularly as a result of: -

- The creation of access tracks which intercept the natural drainage and concentrate water along the track;
- Removal of ground-cover vegetation; and
- Compaction of ground – reducing the permeability of the surface.

No erosion shall be permitted on site. Areas affected by construction related activities shall be monitored on an ongoing basis for evidence of soil erosion. Remedial measures shall be applied at an early stage before a severe erosion problem arises.

3.3.7 Vehicle Access Tracks

Vehicles compact the topsoil making it very difficult for grass to grow. This often causes unsightly scars and soil erosion. A permanent access track will be required for construction and maintenance. In most cases, this track will be aligned within the 12m cleared strip below the conductors. However, in the case of steep slopes, pans, crop lands, or other obstacles, deviations from that 12m strip may be justified or indeed preferred for environmental reasons.

Temporary access tracks may also need to be made to gain access to construction materials e.g. local borrow pits for sand. In relation to the permanent access track in or close to the power line servitude the following requirements shall apply: -

- A single access track only shall be made for the purposes of construction and maintenance of the power line; and
- The Contractor shall maintain this access track in a satisfactory condition for the duration of the Contract such that it is unnecessary to make additional tracks.

In relation to any temporary access tracks that may be required to access borrow pits the following requirements shall apply: -

- No temporary access track shall be made without the prior approval of the Engineer; and
- Temporary access tracks shall be ripped and rehabilitated once they are no longer required.

In the case of both the permanent access track and any temporary tracks: -

- The access track shall be routed to minimise the risk of erosion;
- Multiple access tracks will not be permitted;
- In the event of any infringement, any unnecessary tracks shall be rehabilitated at the Contractor's expense; and
- Anti-erosion measures (e.g. cladding) will be instituted where erosion occurs, specifically related to high rainfall.

3.3.8 Alien Invasive Plants

Construction projects frequently result in the introduction and spread of alien invasive plants. Seed is often imported to site on vehicles and in construction materials. Disturbance to the natural vegetation also creates an opportunity for alien plants to become established. These plants are able to out-compete indigenous plants and therefore represent a threat to biodiversity. Some of the most common species of concern are likely to include *Prosopis spp* (Mesquite), *Ricinus Communis* (Castor oil plant), *Datura spp*, and *Lantana camara*.

A useful reference book is Problem Plants of South Africa (Bromilow, 2001)

The Contractor shall be aware of the threat of alien invasive plants and shall take all reasonable steps to prevent their introduction and spread. A list of alien invasive plant species is contained in Appendix B.

No materials (e.g. sand and stone) shall be imported to site unless from a source that is free of alien invasive plants.

Should any alien plants begin to grow on site, the Contractor shall take appropriate steps to eradicate these before they flower and set seed. Eradication measures may include: -

- Grubbing out young plants (e.g. less than 300mm high) taking care to remove all the roots; and/or
- Poisoning alien plants with a suitable herbicide applied to the leaves and stems.

Ongoing monitoring and eradication is required. This shall be the responsibility of the Contractor during the Contract and maintenance period. Thereafter it shall be the responsibility of NamPower.

3.4 Environmental Specifications: Birds & Aircraft

3.4.1 Bird Anti-Collision Devices & Aircraft Spheres

The power line represents a threat to large birds and aircraft, which may collide with the conductors. To protect aircraft, aircraft spheres are to be fitted to the line near landing strips and roads. To protect birds, anti-collision devices or bird flappers are to be fitted in specified situations where the risks of collision are greatest.

Following construction problems may arise with large birds nesting or perching in towers and becoming electrocuted and causing power interruptions. Therefore further measures may be requested on a needs basis during the maintenance period.

Anti-collision devices shall be installed on the power line in specified locations during stringing of the conductors or immediately thereafter. Refer to Appendix E for associated information on anti-collision devices.

Aircraft spheres shall be installed at the following locations: -

- On any section of the power line that is within 2km of any landing strip for aircraft; and
- Wherever the power line crosses a major road (designated as a B or C route according to the Roads Authority).

Anti-collision devices shall be installed at the following locations: -

- within 2km of any nests of vultures or other large birds (such as eagles);
- within 500m from farm dams or pans;
- within 500m from crossings of seasonal omarambas; and
- within 2km of the Okavango River and Kwando River (on either side) and associated wetlands in the case of overhead lines.

Refer to Appendix E (as above) for the Ornithological component of the study.

3.4.2 Other measures relating to birds

Following construction certain other measures may be required by NamPower in relation to birds nesting or perching on towers. NamPower will provide specifications for such measures if and when the need arises.

3.5 Environmental Specifications: Archaeological Sites

Although no significant archaeological finds were made during the EA, the possibility exists that these could be discovered during construction. Archaeological sites are protected under the National Heritage Act (2004) and must not be destroyed or disturbed. The Act also requires that any archaeological finds be reported to the Heritage Council.

•In the event that any archaeological sites or artefacts are discovered during construction, the Contractor shall: -

- Immediately report such finds to the Engineer, the ECO, and the Heritage Council; and
- Stop the activity which is affecting the particular archaeological material or site and await further instructions.

3.6 Environmental Specifications: Socio-Economic Issues

3.6.1 Access to property

The Contractor shall ensure that the landowner or occupant is notified before any construction-related personnel are allowed on site. NamPower's standard requirements in this regard shall be strictly adhered to.

3.6.2 Social disruption and communication

The Contractor's staff shall in no way be a nuisance to residents in the area. The property and privacy of residents shall be respected. Any complaints received by the Engineer or ECO will be addressed and the guilty persons will face suspension from the project. All site personnel shall maintain good communications with farm owners and local communities. Should any conflict arise between site personnel and the local residents, the Contractor shall report the same to the Engineer without delay.

3.6.3 HIV / AIDS & Tuberculosis Programme

When construction personnel are away from home and family, the opportunity arises for the spread of HIV / AIDS and Tuberculosis (TB). It is now standard practice for tenderers to include a statement on the HIV/AIDS Programme that they will implement if awarded the Contract. For further information contact Namibian Business Coalition on AIDS (NABCOA).

The Contractor shall undertake an HIV/AIDS & TB Programme, which shall include the following components: -

- Education / awareness training & prevention measures,
- Support & Counselling, and
- Care (in the event of personnel becoming sick).

The Contractor shall provide details in the Tender, of the HIV/AIDS and TB Programme that he will implement.

3.6.4 Dust

Dust is regarded as a nuisance when it reduces visibility, creates unpleasant working conditions, or covers vegetation to a degree that it becomes less palatable to animals that eat it. Excessive dust can also represent a health hazard to construction personnel.

The Contractor shall take the necessary measures to suppress dust when working near any sensitive receptors such as dwellings, homesteads, cattle posts that are in use and croplands during the growing season. Near sensitive receptors, spraying with water may be required to suppress dust.

3.6.5 Noise

Noise is a nuisance factor near any sensitive receptors such as dwellings. Silencers shall be fitted on all machinery, noisy equipment and vehicles and these silencers shall be well maintained. Should any excessively noisy activities be required, e.g. blasting, the affected parties shall be notified well in advance.

3.6.6 Water Consumption

Water is a scarce commodity and every effort shall be made to minimise the consumption of water. The Contractor shall restrict the use of water to the minimum that is required for construction activities and domestic use. Wastage shall not be tolerated and all site personnel shall be given instruction in this regard.

3.6.7 Sanitation

Adequate toilet facilities for construction staff shall be provided close to the works. All toilets shall be maintained by the Contractor in a clean sanitary condition to the satisfaction of the Engineer. Toilets shall not be located within 25m of any watercourse, pan, dam, or where the possibility of flooding exists.

Contractors shall instruct their staff and sub-contractors to use the toilets provided and not to defecate in the veld or riverbeds.

3.6.8 Waste Management

Litter and waste materials, rubble etc. can have a number of adverse impacts which can result in ecological or economic impacts.

- Plastics can lead to fatalities when eaten by wild animals or domestic livestock. The plastic causes a blockage in the digestive tract, often with lethal consequences;
- Birds and animals can be trapped in bits of wire or empty containers;
- Toxic materials such as fuels, oils, paints or solvents are dangerous to animals and birds and must not be left lying about;
- Disposal by burning leads to a risk of veld fires and is therefore not permitted;
- Burial of waste is also not permitted as it may lead to contamination of soil or groundwater, or it may be dug up by animals or exposed by erosion; and
- Glass bottles or broken glass lying in the veld can act as a magnifying glass to concentrate the rays of the sun and start a fire.

The site shall be kept clean, neat and tidy to the satisfaction of the Engineer & ECO. The Contractor shall provide bins at the work sites and shall be responsible for the collection and containment of refuse

and waste generated by his staff on a daily basis. Bins shall be secured in such a way that wind cannot remove papers and plastics. Bins shall also be secured against animals such as baboons, genets and jackals.

No burning of refuse is permitted. No waste shall be buried on site. Refuse, construction waste and liquid waste shall be removed regularly and disposed of at an approved waste disposal facility.

3.6.9 Collection of Firewood

Use of wood from trees (timber and firewood) represents an extremely valuable resource to the local communities and ecological functions. Therefore trees that have to be felled should be left as dead wood has an important ecological role to play as it provides food for insects and the birds and animals that live off those insects. The rotting wood also returns nutrients and fibre to the soil, which encourages plant growth.

No firewood shall be collected from site without the prior permission of the landowner, and then only in small quantities as are required for cooking fires.

All wood that must be felled as a requirement under the Contract shall remain the property of the landowner (on private farms). The Contractor shall not remove any wood whether suitable for firewood or construction from site for his own purposes or for sale or donation to any party.

3.6.10 Poaching of Wildlife

It is an offence to poach wildlife whether enclosed in a game proof fence or not. No birds or animals shall be captured, killed or harmed in any way. Anyone caught infringing in this regard will face suspension from the project, and shall be liable for prosecution.

3.6.11 Gates and fences

Farmers are concerned that livestock or wildlife may escape as a result of gates and fences being left open. The Contractor shall ensure that no gate or fence is left open without the prior knowledge and consent of the farmer concerned and the engineer. Wherever it is necessary for fences to be open, e.g. during the installation of gates, the openings shall not be left unattended at any time to prevent the escape of livestock or wildlife.

3.6.12 Fire Prevention & Control

Fire represents a serious threat to livestock, wildlife, vegetation and property. They can result in widespread loss of grazing and destruction of woodlands with serious ecological and economic consequences.

Fires may be caused by smoking, welding, cooking fires, and glass bottles left lying in the grass in the sun. Fire may spread very rapidly, especially during the dry season and windy conditions.

The Contractor and his staff shall be very conscious of fire risks. The Contractor shall hold fire prevention and management talks with staff to create an awareness of fire risk and actions required to extinguish fire if accidentally started. Regular reminders to staff on this issue are required, especially during the dry season.

The following should be adhered to:

- Cigarettes shall be properly extinguished and the ends shall be disposed of in bins and not left lying around;
- Welding shall be carried out at a safe location after clearing grass and any other flammable material to a safe distance around;
- No fires shall be made other than for the purpose of cooking. Cooking fires must be contained in a fire drum and be in a designated area approved by the Engineer;
- No fire shall be left unattended at any time;
- All fires are to be extinguished once they have served their purpose;
- No burning of grassland or other vegetation is permitted for any reason;
- No burning of refuse is permitted;
- Glass bottles or broken glass shall not be left lying in the sun at any time;
- Fire extinguishers and water tanks shall be on hand at all work stations, at all times. Particularly care shall be taken whenever welding or any other spark generating activity is conducted;
- In addition, rubber beaters shall be on hand at all work stations at all times as these represent the quickest form of response to fire;
- Staff shall be trained how to use the fire-fighting equipment available to them;
- In the event of a fire the Contractor shall immediately employ such equipment and labour as is at his disposal and shall take all other necessary action to bring any such fire under control; and
- The Contractor shall be liable for all costs and damages resulting from fire and fire fighting.

4 REQUIREMENTS FOR ENVIRONMENTAL MANAGEMENT: OPERATIONS & MAINTENANCE STAGE (INCLUDING DECOMMISSIONING)

4.1 Roles and Responsibilities for Environmental Management

The roles and responsibilities that were set out in Section 3.1 above shall also apply for the Operations and Maintenance Stage to some degree. NamPower shall use the relevant portions of Section 3.1 above as guidelines when conducting maintenance of the power line and related infrastructure such as access tracks.

In addition, NamPower must ensure that routine inspections of the power line route are undertaken by a suitably qualified Environmental Control Officer post construction. The main purposes will be to: -

- Inspect for any alien invasive plants that may have become established; and
- Inspect for any soil erosion that may be developing.

The best time of year for these inspections should be late in the rainy season (e.g. between February and March) so that any alien plants are visible, and erosion is apparent.

The Environmental monitoring inspections should probably be carried out with the NamPower team that does routine inspections of the power line. Ideally, they should be accompanied by some labourers to eradicate alien plants and undertake any anti-erosion works at the same time as the inspection. During the inspection, the ECO should also consult with the landowners and establish whether there have been any fatalities with birds that need to be addressed.

4.2 General

The Environmental Specifications set out in Sections 3.2 – 3.6 shall apply also to the Operations and Maintenance stage, whether the work is done in-house by NamPower or by an external Contractor.

In addition Sections 4.3 – 4.5 below draw attention to specific issues to be addressed by NamPower on an ongoing basis, which may not be adequately covered in Section 3. Issues such as soil erosion, alien invasive plants, clearing of encroacher bush (indigenous) species, birds, and building of dwellings and structures within the power line servitude will require ongoing monitoring and management.

4.3 Ongoing Management: Vegetation & Soils

4.3.1 Bush encroachment

The clearing of the 12m corridor under the conductors will, in some areas, result in rapid regrowth of certain indigenous encroacher species such as *Acacia mellifera* (Swarthaak) and *Dichrostachys cinerea* (Sekelbos).

NamPower requires that the 12m corridor be kept free of tall woody vegetation, and doing so will benefit the grazing potential of this land. Therefore, the following recommendations are made to achieve control over encroacher species.

After the initial clearing, rapid germination of seed, which is stored in the soil for long periods, can be expected. Follow-up spraying with selective herbicide represents the best form of control over such re-growth. It will probably be necessary to repeat spraying in the second year after the initial clearing, and then periodically as required.

Failure to spray the re-growth before it flowers and sets seed will have the following consequences:

- Dense growth of thorny young trees will make access difficult; and
- Seed production will aggravate the problem of maintenance.

4.3.2 Soil erosion

Ongoing monitoring is required to establish whether any erosion is developing, particularly in relation to access tracks and borrow pits. In the event of erosion developing, prompt remedial measures are recommended to avoid costly rehabilitation measures later. Anti-erosion measures, such may be required in places – refer to Sections 3.3.7 – 3.3.10 above.

4.3.3 Alien invasive plants

Ongoing monitoring is required to identify any alien invasive plants as it very likely that these will be introduced and/or spread along the power line route. It must be emphasised that the growth and spread of alien plants tends to be exponential. Therefore early eradication is essential.

Refer to Section 3.3.11 for further details.

4.4 Ongoing Management: Birds

4.4.1 Landowner participation

It will be impractical for NamPower to monitor the fatalities to birds on a routine basis. If birds are killed they are likely to be consumed by jackals and vultures. It is therefore recommended that NamPower should encourage farmers to report any bird fatalities or other problems to NamPower's Environmental Officer. The Environmental Officer should keep a record of all reports on an ongoing basis stating the date, species (or at least the genus), the manner in which the bird was killed or the nature of the problem.

These records should then be used to determine the needs for additional measures to protect birds.

4.4.2 Anti-Collision Devices

In the event of significant numbers of collisions at particular locations, extra bird flappers may be required. In some cases luminous bird flappers may be required so that they are visible to birds flying at night.

4.4.3 Other devices to protect perching or nesting birds

In the event of perching or nesting birds being electrocuted, devices may need to be added to the towers on a needs basis.

4.5 Ongoing Management: Socio-Economic Issues

4.5.1 Monitoring and prevention of construction within the servitude

As a precautionary measure in relation to electro-magnetic fields, it is recommended that no dwelling, or any other building should be permitted within 100m to 300m from the power line.

4.6 Decommissioning

Eventually the power line will need to be decommissioned and removed. Most of the requirements for the Operations and Maintenance stage must also be applied to the Decommissioning stage. In addition, the demolition of towers will generate a lot of waste. Steel must be re-used or recycled. Other waste materials that cannot be recycled must be removed to an approved waste disposal site.

5 REFERENCES

National Botanical Research Institute (NBRI) Tel. 061 - 2022023

A permit is required from the Directorate of Forestry (MAWF) to remove any protected trees. (Tel. 061 – 221478, 221511 or 221671)

For other protected plants, e.g. aloes, succulents, bulbs, a permit is required from the Ministry of Environment and Tourism. Contact the Permit Office at MET (Tel. 061 – 263131).

Heritage Council and J.Kinahan (Tel. 061 – 256702 / 236216)

Useful Reference Material

Birds & Power Lines” (Ferrer & Janss eds. 1999).

Problem Plants of South Africa (Bromilow, 2001).

Appendix A: Important Protected Plant Species

Nomenclature follows Craven (1999)

Acacia erioloba
Acacia haematoxylon
Acacia montis-usti
Acacia robynsiana
Acacia sieberana
Acanthosicyos horidus
Adansonia digitata
Albizia anthelmintica
Baikiaea plurijuga
Berchemia discolor
Boscia albitrunca
Burkea africana
Colophospermum mopane
Combretum imberbe
Elaeodendron transvaalensis (= *Cassine transvaalensis*)
Entandrophragma spicatum
Erythrina decora
Euclea pseudebenus
Faidherbia albida (= *Acacia albida*)
Ficus cordata
Ficus sycomorus
Ficus thonningii
Guibortia coleosperma
Kirkia accuminata
Lansea discolor
Lonchocarpus capassa
Lonchocarpus nelsii
Maerua schinzii
Ochna pulchra
Olea europea subsp. *africana*
Ozoroa crassinervia
Pappea capensis
Parkinsonia africana
Peltophorum africanum
Pterocarpus angolensis
Rhus lancea
Salix capensis
Schinziophyton rautanenii (= *Ricinodendron rautanenii*)
Schotia afra
Sclerocarya birrea
Securidaca longipendunculata
Spirostachys africana
Sterculia africana
Strychnos cocculoides
Strychnos spinosa
Tamarix usinioides

Appendix B: Alien Plant Species

Alien Invasive Plants in Namibia

This list contains the names of some of the most common and problematic alien invasive weeds in Namibia. The list is not comprehensive.

Species	Common Name	Description (The numbers in brackets indicate the typical height)
<i>Schinus terebinthifolius</i>	Brazilian pepper tree	Tree (3-6m). Dark green glossy leaves, bunches of red berries
<i>Jacaranda mimosifolia</i>	Jacaranda	Tree (6m). Fine compound leaves and purple flowers
<i>Acacia mearnsii</i>	Black wattle	Tree 5m). Compound leaves, yellow pom-pom flowers, many pods
<i>Melia azedarach</i>	Syringa	Tree (3-7m). Lilac flowers, Marble-sized yellow / orange berries remain on the tree for a year or more. <i>Berries are believed to be poisonous to humans.</i>
<i>Nicotiana glauca</i>	Wild tobacco	Tree (3-6m). Slender tree with greyish leaves, yellow tubular flowers
<i>Ricinus communis</i>	Castor-oil plant	Bush (2-4m). Large palmate leaves with about 7 points, large spiky pods.
<i>Prosopis glandulosa</i>	Mesquite	Tree (6m). Compound leaves, thorny, long pods like acacias. <i>Very difficult to eradicate once introduced!</i>
<i>Lantana camara</i>	Common lantana	Bush (1-4m). Rough leaves, square stems (in cross section) with rows of small thorns on the corners of the stems. Pink & yellow flowers. Green fruit – 5mm, turns black when ripe.
<i>Datura ferox</i> <i>Datura stramonium</i>	Large thorn-apple Common thorn-apple	Bush (1,5m). Large soft leaves, spiky pods, large white trumpet-shaped flowers. <i>Seed and seedlings are poisonous & have caused fatalities to humans. Also invades crops.</i>
<i>Cereus jamacara</i>	Queen of the night	Tall cactus (6-7m). Fluted stems with long spines / thorns. Large attractive flowers.
<i>Harrisia martinii</i>	Moon cactus	Bushy scrambling cactus (1-2m). Very thorny.
<i>Opuntia ficus-indica</i>	Prickly pear	Cactus bush (1,5-3m). Large, oval succulent leaves. Yellow or orange flowers, Large edible but thorny fruit.
<i>Opuntia aurantiaca</i> <i>Opuntia imbricata</i>	Jointed prickly pear / Imbricate prickly pear. Both are also know as “Jointed cactus”	Bushy scrambling cactus (0,5-3m). slender thorny stems.
		Note that all cactuses are alien to Namibia. They must not be confused with Euphorbias which are indigenous and have a cactus-like appearance.

For more details on these plants – identification, description, and control and eradication measures, refer to Problem Plants of South Africa (Bromilow 2001) Briza, Pretoria. This book is available in Namibia.

Appendix C: Important Bird Species

The following Red Data species would be extremely vulnerable to collisions with an overhead power line across the two rivers in question. Their conservation status is shown in bold:

- Great White Pelican *Pelecanus onocrotalus* **Vulnerable**

Scarce non-breeding visitor. Small groups have been recorded, most often during the period when the floodplains are drying up and fish are trapped in channels and ponds.

- Pinkbacked Pelican *Pelecanus rufescens* **Vulnerable**

Rare non-breeding visitor. Solitary individuals have been recorded in most months. Both Pelican species are large enough to be vulnerable to power lines.

- Slaty Egret *Egretta vinaceigula* **Vulnerable**

Scarce (non-breeding) resident. Globally threatened. Recorded throughout the year in small numbers – increasing during periods of declining floods, most often seen in areas with floating mats of *Echinochloa* and *Vossia*. This is not a very large bird and it is not known whether these would be vulnerable to collisions with power lines.

- Whitebacked Nightheron *Gorsachius leuconotus* **Endangered**

Rare resident. Recorded most often in dense wooded thickets overhanging the river. This species is probably most common in the Mukwe-Divundu area where it occurs in dense *Syzygium guineense* thickets. Very young birds have been recorded in March/April and the species may breed in the area. The species is considered by some to be continentally threatened.

- Saddlebilled Stork *Ephippiorhynchus senegalensis* **Endangered**

Scarce visitor. Recorded throughout the year in Mahango Game Park in very small numbers (< 5 birds). It is generally found feeding in wet floodplain habitats, along the edge of the river channels and in ephemeral pans. This large species would be very vulnerable to power lines. It is considered to be continentally threatened.

- Marabou Stork *Leptoptilos crumeniferus* **Rare**

Uncommon to common visitor. Recorded in all months of the year, this species is found throughout the area in wooded as well as open floodplain and riverine habitats.

- Yellowbilled Stork *Mycteria ibis* **Vulnerable**

Scarce to uncommon visitor. Recorded in small numbers throughout the year. This species favours riverine habitats, lagoon margins, flooded grasslands, swamps and marshes. Large and very vulnerable to power lines.

- Sacred Ibis *Threskiornis aethiopicus* **Rare**

Scarce (non-breeding) resident. Formerly common in floodplain habitats, this species has become scarce since the destruction of its main breeding sites by Elephant and fire. Now only seen irregularly in small numbers. Not a very large bird but possibly vulnerable to power lines.

- Glossy Ibis *Plegadis falcinellus* **Vulnerable**

Uncommon to scarce visitor. Recorded in small numbers in the summer months, but is most common during periods of declining floods from April to July. Not a very large bird but possibly vulnerable to power lines.

- Hadedda Ibis *Bostrychia hagedash* **Vulnerable**

Rare visitor. There are isolated records of this species from the study area. Apparently suitable breeding and feeding habitats exist especially on the islands in the Mukwe-Divundu area.

- African Marsh Harrier *Circus ranivorus* **Vulnerable**

Uncommon to rare resident. During the late dry season few birds recorded as most of the floodplain is dry. With the onset of the floods numbers increase markedly. Probably breeds in the floodplain areas of the Mahango Game Park. Possibly vulnerable to power lines.

- African Fish Eagle *Haliaeetus vocifer* **Vulnerable**

Uncommon resident along the river and associated floodplain habitats. Numbers are lower during the breeding season when territories are aggressively defended. Numbers increase considerably during the late dry season (October) Probably vulnerable to power lines while flying over the river hunting for fish.

- Western Banded Snake-Eagle *Circaetus cinerascens* **Critically Endangered**

Scarce resident - restricted to the densely wooded riverine strip. A small population occurs in the Mukwe-Divundu area with the birds known to breed on some of the islands there. Possibly vulnerable to power lines.

- Wattled Crane *Grus carunculata* **Critically Endangered**

Scarce resident. Found on floodplains along the rivers, usually in pairs or family groups of three. They breed soon after high-water in May/June. **This species is considered globally threatened. It would definitely be vulnerable to overhead power lines.** The study area is a major global stronghold for this species and they must be considered to be of the highest conservation concern.

- African Finfoot *Podica senegalensis* **Critically Endangered**

Rare. May occur in the Mukwe-Divundu area on wooded river margins and island forest. These birds require river margins with dense overhanging vegetation. Vulnerability to power lines unknown, but it tends to fly low over the water.

- African Skimmer *Rhynchops flavirostris* **Endangered**

Uncommon breeding intra-African migrant. Present in the study area as soon as sandbanks become exposed enough to allow roosting July to February when sandbanks are once again inundated. Breeds in extended colonies on sandbanks from late August/September to October. Possibly vulnerable to power lines.

- Coppery-tailed Coucal *Centropus cupreicaudatus* **Vulnerable**

Common resident. Recorded in all months of the year. Restricted to floodplain and riverine habitats, seldom venturing into riparian woodlands. Probably vulnerable to power lines.

- Pel's Fishing Owl *Scotopelia peli* **Critically Endangered**

Scarce resident. Recorded in all months of the year. Most often recorded in riparian woodland and tall trees along the main river course, but may be found roosting up to 200 m from the river. Several territories are known from the Mukwe-Divundu islands. Any loss of the large trees within the riparian habitats (through inundation) will lead to a significant reduction in the local population. These birds are probably also vulnerable to collisions with power lines.

Other small species in the area, which that are Red Data listed, include: -

- Red-winged Pratincole *Glareola pratincola* **Vulnerable**

Common resident. Found in large flocks (>500 birds) on sandbanks and short grass habitats on the main floodplains. Breeds in extensive colonies from September to December during periods of low water.

- Rock Pratincole *Glareola nuchalis* **Vulnerable**

Common breeding intra-African migrant. Occurs from June to March/April on rocky rapids from Mukwe to Divundu and downstream to the Mahango area. Breeds from December to March. Their breeding habitat is very restricted, and the above-mentioned river section is a regional stronghold of this species in southern Africa.

- Greater Swamp Warbler *Acrocephalus rufescens* **Vulnerable**
Common resident. Only occurs in dense stands of Papyrus and other tall aquatic grasses and reeds.

Due to the small size of these three species they are probably not vulnerable to power lines.

Appendix E: Ornithological Study and Anti-Collision Devices

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