Nov
2023

Draft Environmental and Social Impact Assessment for the Proposed 400 kV Auas-Kokerboom Transmission Line

VOLUME 2 OF 3

APPENDIX F: TECHNICAL SPECIALIST REPORTS

ENVIRO DYNAMICS

PROJECT NAME	Environmental and Social Assessment for the Proposed Auas-Kokerboom 400 kV Transmission Line
STAGE OF REPORT	Draft Environmental and Social Impact Assessment Report
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DATE OF SUBMISSION	November 2023
CONTRIBUTORS TO THE REPORT	Stephanie van Zyl, Eddy Kuliwoye (Mapping)

DECLARATION

I hereby declare that I:

- have knowledge of and experience in conducting assessments, including knowledge of the Environmental Management Act (7 of 2007), its regulations and guidelines that have relevance to the proposed activity;
- have performed the work relating to the application in an objective manner, regardless of whether or not the views and findings were favourable to the applicant;
- have complied with the Act, and its regulations, guidelines and other applicable laws.

I also declare that there is, to my knowledge, no information in my possession that reasonably has or may have the potential of influencing –

- any decision to be taken with respect to the application in terms of the Act and its regulations; or
- the objectivity of this report, plan or document prepared in terms of the Act and its regulations.

Stephanie van Zyl
Environmental Assessment Practitioner (EAP)

EXECUTIVE SUMMARY

INTRODUCTION

NamPower intends constructing a 461 km long 400kV transmission line from the Auas Substation near Dordabis to Kokerboom substation near Keetmanshop, Namibia, as shown on the map overleaf. The line will assist in securing the supply of electricity to Namibia in future and open up opportunities for selling power to the Southern African Power Pool (SAPP).

NamPower is currently applying to the World Bank for funding of the project, which will entail the following:

- The new Auas-Kokerboom 400kV Transmission Line, with associated infrastructure at both substations such as switchgear and reactors.
- A Battery Energy Storage System (BESS) to be installed at Lithop Substation, that will enable NamPower to store energy generated by, amongst other, renewable sources such as solar or wind energy to allow utilisation of such energy when these resources are not available, such as after sunset.

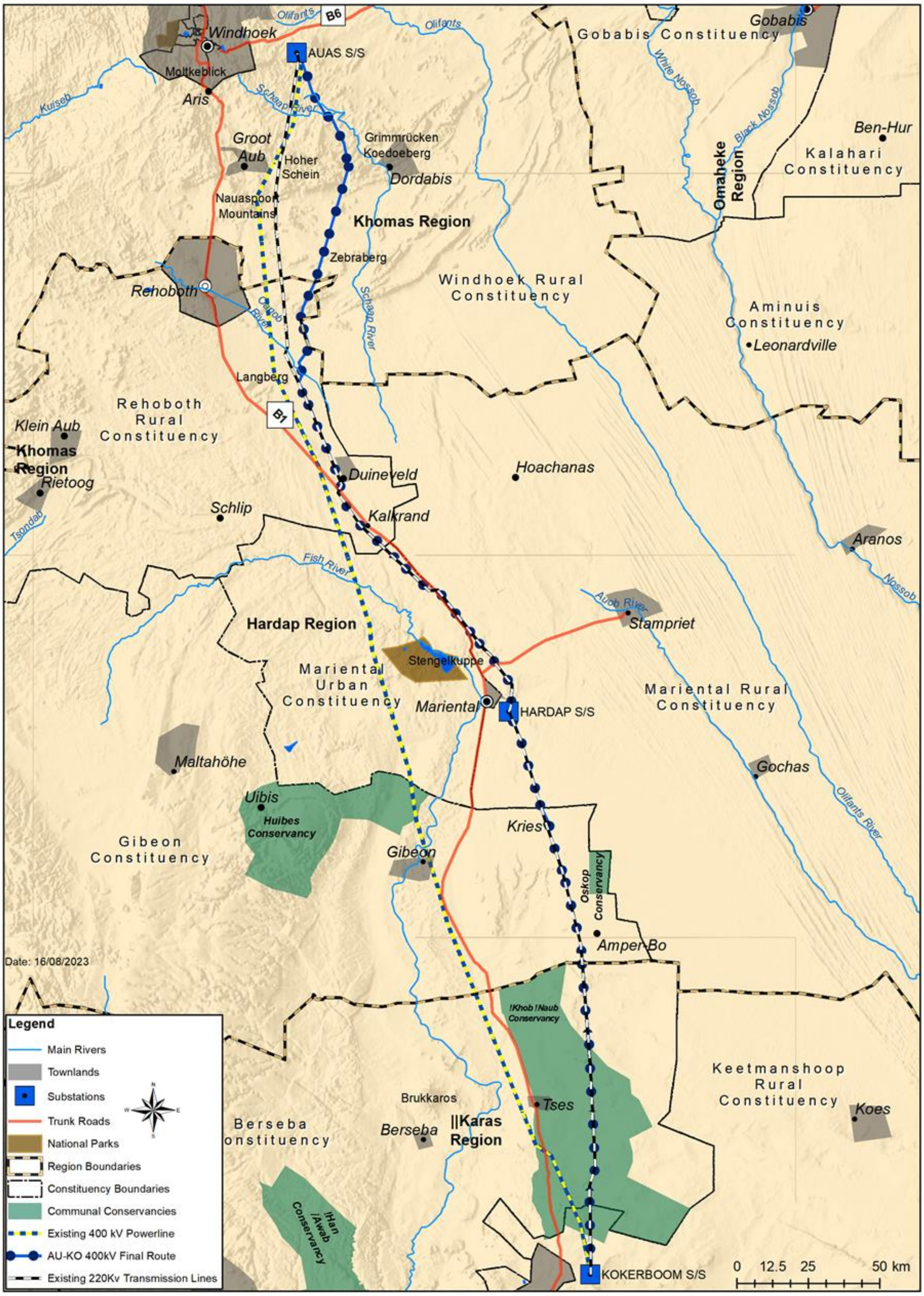
An Environmental Impact Assessment for this project was completed in 2020 and an Environmental Clearance Certificate obtained for it in terms of Namibia's Environmental Management Act, in 2021. The World Bank's Environmental and Social Framework, consisting of ten Standards should be adhered to as a condition for the loan.

Environ Dynamics was appointed to update the 2020 ESIA and ESMP, to meet all the above Standards where gaps are identified. This ESIA Report, together with the Appendices contains the findings of this work, including the required Management Plans necessary to implement satisfactory mitigation during construction and operation.

PROJECT DESCRIPTION

This Environmental and Social Impact Assessment (ESIA) was prepared for the proposed construction of a single-circuit 400 kV transmission power line from the Auas substation (near Dordabis) to the Kokerboom Substation (near Keetmanshoop) (hereafter refer to as the "*Project*"). The length of the transmission line is approximately 460 km. The transmission power line will have a final servitude of 80 m width, with 12 m of that being cleared for an access track.

The preferred transmission line route follows the existing 220 kV transmission corridor from the Kokerboom substation in the south for a distance of approximately 165km, after which it deviates to the east; to largely avoid homesteads, infrastructure and major topographic features; and passes through the Nauaspoort Mountain towards the Auas substation located in the north near Dordabis/Windhoek.



Locality map of the Auas-Kokerboom 400kV Line Route

The tower designs along the majority of the route will consist of cross rope suspension towers (V-Structures), with self-supporting and strain towers in strategic points. The construction period will be approximately thirty-six months and it is likely to proceed on multiple construction fronts. Existing access roads will be utilized as far as reasonably possible to access the construction corridor.

As shown in the diagram below, two alternative routes were considered namely, the western route which largely follows the existing 400kV transmission line and the eastern route (preferred option), which largely follows the existing 220kV transmission line. A comparative analysis was done between these two route options. It was concluded that the potential impacts on the western route will be marginally smaller, with ~3%, because of its slightly shorter distance. However, the western route is considered technically unfeasible due the route crossing the existing 200kV line, which will need the installation of a tower to ensure safe clearance. The close proximity of the two 400kV lines also increases the risk of a failure (power outages) of both lines, which is of national significance.

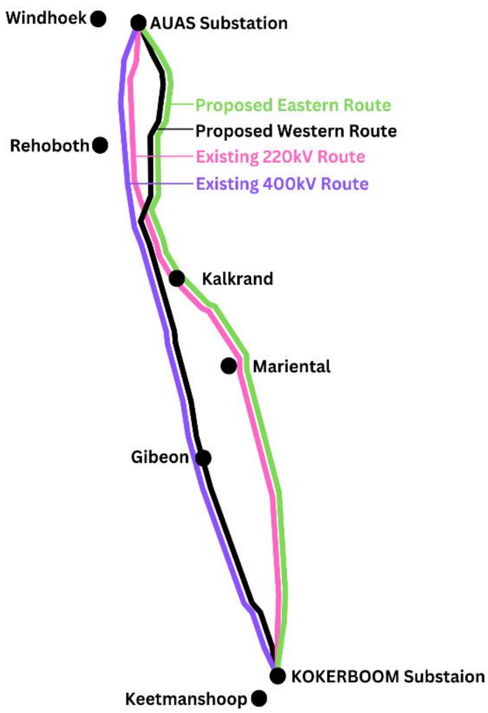


Diagram illustrating western and eastern alternative routes

MAIN IMPACT RISKS AND PROPOSED MITIGATIONS

Critical Habitat

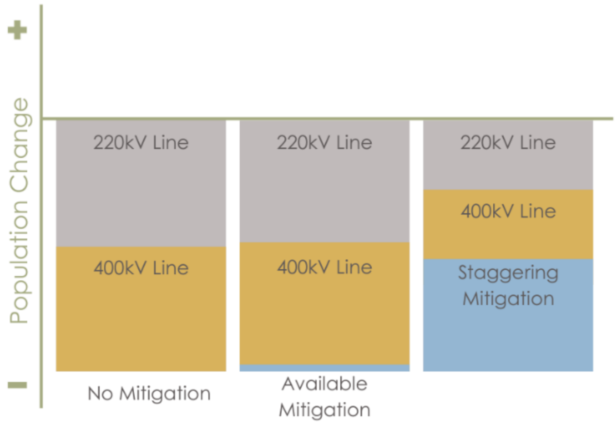
It is concluded from the Critical Habitat Assessment, that given all the ESS6 criteria combined, the Karas Dwarf Shrubland and Dwarf Shrub Savanna which cover the study area to the south are considered critical habitat for the **Ludwig's Bustard**. The **Ludwig's Bustard,** which is classified as Globally Endangered, according to the IUCN Red Data list of species and listed as Endangered on the Namibian Red List, prefers open grassland found in the mentioned habitats. Within these habitats, the Hardap Dam is also an Important Bird Area and an important site for the migratory species Great White Pelican. Even though the dam is some 10km to the west of the proposed route, birds flying to and from this site can potentially collide with the power line.

Despite the fact that these habitats are considered important areas for Ludwig's Bustard and other species of conservation concern, it is the presence of the power line as a physical barrier, which poses the threat in terms of potential collisions, and needs to be addressed intentionally.

Biodiversity Risk Management (or mitigation) measures following a mitigation hierarchy approach have been considered in the Critical Habitat Assessment. The goals of No Net Loss and Net Gain should be set in the Biodiversity Management Plan.

A staggered design (i.e., the "staggering" or offsetting of pylons of the new 400 kV line with those of the adjacent 220 kV line) is being proposed, to increase the visibility of the obstruction of the power line infrastructure to flying birds, and thus reduce the chances of collisions. Since regional monitoring shows that current available mitigation, i.e., marking of lines to make them more visible, is ineffective for Bustards, the staggering mitigation is considered a potential solution and as such it is anticipated that the number of bird deaths at a regional scale can be significantly reduced. The staggering mitigation proposal is based on data which shows that most collisions take place mid-span between pylons, indicating that the pylons could be an effective visual barrier.

The diagram below indicates the risk of the alternative mitigation methods. The existing 220kV line is not mitigation, and should another transmission line be added, the bustard collisions will effectively double. Should available mitigation be applied, there is expected to be a very small change to curb the bustard collision risk. The staggering mitigation option, however, is expected to reduce collisions on both lines, with approximately 45%. Not only will this be a major advance for the bustard population's future on this project, but also as a potential future mitigation option on projects in the region with similar risks.



Bustard collision mitigation options compared.

Though the confidence in the proposed staggering is high, the approach has not yet been proven, and will be applied as a trial to determine the effectiveness of staggering transmission lines to reduce bird collisions. It is proposed that, prior to construction, further studies, in addition to consultations with avifauna specialists, be conducted to refine this approach as a mitigation measure as part of the finalization of the design. This preparation period will also be used to refine the power line marking methods to be used for specific avifauna hotspots, and as preparation of a robust monitoring plan in the BMP. A plan of study is being proposed to set the terms for this further work prior to construction.

The BMP will set out a short (pre-construction), medium (during construction) and long term (post-construction) monitoring programme. The BMP will in particular focus on the monitoring of key critical habitat areas, to assess the effectiveness of the mitigation measures that have been proposed thus far (staggering and line markers), with an aim to achieve Net Gain. A further aim of the monitoring is to assess local population numbers and trends of sensitive bird species (especially bustards) that are using these key critical habitat areas.

The BMP will contain the requirements for further, ongoing biodiversity monitoring during the operational phase, to evaluate how effectively the mitigation measures proposed are in achieving the Net Gain targets.

Impact assessment

The impact assessment carried out revealed the following significant effects:

- **Impact on vegetation:** Because of the linear nature of the project, the impact on vegetation is expected to be generally low. The loss of protected tree species, specifically the protected Camel Thorn rates medium and can be reduced to achieve a low significance with on-sit final route selection and proper vegetation management. Appropriate mitigation is included in the Biodiversity Management Plan (BMP).

- **Impact on avifauna:** The project area supports a relatively high diversity of red data species, including Vultures, Eagles, and Bustards that are particularly vulnerable to power line collisions. The main impact on birds will be bird strikes once the line is operational. The route has been aligned along an existing 220kV transmission line to minimise cumulative impacts. However, there still remain habitats that harbour sensitive red data bird species. Mitigation measures, which are a non-negotiable condition should be implemented, namely staggering the 220kV with the 400kV pylons (to be the same height to increase the chance of bustards seeing and clearing both lines), and where this staggering is not possible or ineffective after a period of monitoring, the line be marked with bird diverters. Bird marking is recommended for specific hotspot areas, where this type of mitigation is expected to be effective. A rigorous monitoring programme, is proposed, as discussed for Critical Habitat.

- **Social impacts:** The most significant impacts include disruption to farm management and changed sense of place. For some farmers the key impact will be during construction when the team interferes with and could potentially introduce nuisances on their farms such as noise, dust, security risk, poaching, etc. to their land. This impact will continue periodically during operation when maintenance is carried out on the line. Some owners are concerned who already have a number of lines crossing their land. For some who place a high value on view sheds, their sense of place will change. These impacts are low generally for the entire route, but rated high to medium for some receptors.

  NamPower has made significant efforts to accommodate farm owners concerns in this regard, by making route adjustments where possible. Mitigation of potential nuisance and conflict on farms during construction and operation includes a well-planned management and communication protocol. There will be no resettlement or land take on this project. Land restrictions include that no structures be erected within the project servitude. Farms are generally large and used for grazing under the transmission line corridors. Grazing may continue without interruption. NamPower's efforts to compensate for the land restrictions are considered reasonable and do satisfy the World Bank's Environmental and Social Standard: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement.

  The limited land use restrictions are expected to have a low impact on the Nama Traditional Local Community, considered an Indigenous People group according to the World Bank ESS7. Engagement with the group's representatives, including those of the! Hob! Naub Conservancy, confirmed this assessment. The conservancy is large, none of their settlements or structures will be affected and livelihood strategies will continue mostly unaffected. Continued engagement with this group is very important and recommendations have been made to limit impact on the community during construction. A recommendation is also made to include a social upliftment programme targeting the Nama community, into the project implementation.

- **Impact on archaeology:** Three sensitive sites have been discovered along the route, including one burial cairn, a grave (both in the south near Keetmanshoop) and a graveyard (on one of the commercial farms along the northern section of the route). These are not directly on the route (, i.e., between 2-4km away from the servitude boundary), but may be implicated during construction and operational activities in the area, particularly vehicles driving on the access track. The sites should either be marked and protected, or if this is not possible, removed completely before construction commences. The impact on these sites is rated high and the careful consideration of how to protect them is crucial.

Other impacts, including impacts on labour, impacts related to waste, and community health and safety issues, have been assessed and should be addressed as part of the ESMP and the directives in the World Bank ESS.

Cumulative Impact Assessment

The cumulative impacts of the existing 220kV transmission line combined with the additional proposed 400kV transmission line were considered at a preliminary level. Impacts on the following Valued Environmental and Social Components (elements that are of value in the area), were assessed:

- Health of vegetation, particularly *Vachellia erioloba*. The cumulative impact is expected to be low. The final survey of the power line should attempt to avoid these species as far as possible, and trees should be trimmed rather than removed where feasible.
- *Health of bird populations particularly those susceptible to power line collisions especially Ludwig's Bustard and Kori Bustard*. This impact is significant and a key focus of this study. By staggering the pylons, the impact is probably significantly reduced on both lines, resulting in possible Net gain. Bird markings and monitoring is also crucial to mitigate the impact, as prescribed in the Biodiversity Management Plan.
- Visual quality as a tourism resource. Because of the increasing number of transmission lines, especially close to tourism related activities existing or planned, this impact is a concern. Rerouting has been done on the applicable farms where possible.
- *Social conditions on farms (specifically power line construction workers and maintenance teams)* will likely be impacted. Farm owners have had to deal

with the related frustrations in the past, and this project will likely add to these frustrations. Maintenance teams accessing the farms to work on the multiple lines adds to this social concern. Protocols for interactions on the farms have been included in the ESMP. The grievance redress mechanism provided for this project is crucial in terms of dealing with conflict and management of maintenance teams on the farms.

RECOMMENDATIONS

In light of what can be concluded regarding the potential impacts associated with the proposed transmission line, NamPower will be able to reduce the significance of most of these to acceptable levels if they implement the mitigation measures outlined in both the Construction and Operational ESMP. The BMP, SEP and LMP also need to be implemented. The preliminary BMP that was previously prepared as part of the ESMP will be updated according to the Plan of Study, contained in the biodiversity and critical habitat assessment, to refine biodiversity mitigation and monitoring, particularly as it relates to avifauna impacts and monitoring. It is important that the ESMP is audited to ensure compliance and that monitoring takes place as outlined therein otherwise the impacts identified will remain unacceptable.

VOLUME 1: ESIA MAIN REPORT

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AVIFAUNAL ASSESSMENT
DRAFT BIODIVERSITY AND CRITICAL HABITAT ASSESSMENT REPORT
ARCHAEOLOGICAL ASSESSMENT
VEGETATION ASSESSMENT
FLOODLINE ASSESSMENT
SOCIAL IMPACT ASSESSMENT

VOLUME 3: APPENDIX G ENVIROMENTAL AND SOCIAL MANAGEMENT PLAN

DRAFT ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

PROPOSED KOKERBOOM – AUAS 400 KV TRANSMISSION LINE

ENVIRONMENTAL IMPACT ASSESSMENT

Avifaunal Assessment Report
For input into the Impact Assessment Report

Birds and Bats Unlimited Environmental Consultants

August 2018

DECLARATION OF INDEPENDENCE

I, Dr. Rob Simmons, as duly authorised representative of Birds and Bats Unlimited confirm my independence (as well as that of Birds and Bats Unlimited) as a specialist and declare that neither I nor Birds and Bats Unlimited have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Lithon Project Consultants (Pty) Ltd was appointed to managed the Environmental Impact Assessment (EIA) process or Ms. Jaana-Maria Ball was appointed as Environmental Assessment Practitioner in terms of the Environmental Management Act, 2007 (Act No. 7 of 2007) and the EIA Regulations, 2012, other than that a thorough and professional assessment is completed for which fair remuneration is made for worked performed, specifically in connection with the EIA process for the proposed Kokerboom to Auas 400 kV transmission line. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – within the limitations as are described in my attached report.

My expertise and experience is as follows:

- I am an avian ecologist and conservationist with 30 years' experience in avian research and impact assessment work;
- I have published over 100 peer-reviewed papers and 2 books on birds and mammals (see https://scholar.google.com/citations?hl=en&user=Mjv8zisAAAAJ&view_op=list_works for details);
- About 64 projects and impact assessments over 23 habitats have been undertaken throughout Namibia, Lesotho, Angola and South Africa with my partner M. Martins;
- I actively research with my students (i) why certain threatened species are susceptible to collision with turbines in South Africa; (ii) innovative mitigation measures to reduce vulture deaths at wind farms and reduce bustard deaths along the transmission lines; (iii) increasing the efficiency of Vantage Point observations at wind farms with graduate students at the FitzPatrick Institute and Centre for Statistical Sciences, UCT;
- I am continuing long-term research on threatened species (raptors, flamingos and terns) and their predators (cats) with UCT students;
- I am finalising guidelines for monitoring and protecting Black Harriers at wind farms with Birdlife South Africa;
- Further Details at http://www.fitzpatrick.uct.ac.za/fitz/staff/research/simmons

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Full Name:	Dr. Robert E Simmons
Title / Position:	Avifaunal Specialist, Director: Birds and Bats Unlimited
Qualification(s):	PhD (Wits), MSc (Acadia, Canada) BSc Hons (Univ College Lond.)
Prof. Membership:	Birdlife South Africa
Experience:	30 years in avian research and impact assessments
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EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

AVIFAUNAL ASSESSMENT REPORT FOR INPUT INTO THE ENVIRONMENTAL IMPACT REPORT

EXECUTIVE SUMMARY

NamPower propose to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km. There are two existing transmission lines connecting the two substations, a 400 kV and a 220 kV line but this infrastructure alone is considered inadequate to meet the future needs of the transmission line system. The pylon height will be approximately 40 m and the distance between pylons approximately 500 m. The purpose of the proposed Project is to strengthen the overall transmission network within Namibia. It is proposed to be constructed in approximately 10 years' time (i.e. 2026), and possibly earlier if the Kudu Gas Project comes on line earlier than expected. Without upgrades to the transmission line network electricity supply in Namibia will in future become constrained, and as a result restrict development (mining, industrial and residential) and negatively impact quality of life in the country as a whole.

This independent Avifaunal Assessment forms part of the full Environmental Impact Assessment (EIA) process undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966) and the EIA Regulations, 2012.

This Avifaunal Assessment Report is based partly on national long-term bird data collection projects sourced from the Namibia's Avifaunal Database (NAD), and mainly on an on-site survey sampling 157 km of the proposed route and existing power lines. These provide data on the occurrence and relative abundance of all bird species in Namibia, per 15 min by 15 min (quarter degree) grid square, and around the power lines themselves. A list of all bird species that have been recorded in the project area was extracted from the NAD. Each species was then assessed in terms of its Red Data status and whether it is endemic to Namibia and to southern Africa. This forms the basis of an assessment of the risk that each species might face as a result of the proposed power line. This was field-verified during the 2017 surveys of avian fatalities on existing power lines in the same habitat that the proposed Auas-Kokerboom power line will traverse. These data were themselves augmented with systematic power line fatality data provided by J Pallet (unpubl data), providing confirmation of the rate of fatalities of the priority collision-prone species.

The proposed Kokerboom to Auas 400 kV transmission line was divided into four sections based on the vegetation types through which it runs:

1. Kokerboom to near Mariental (about 205 km), through Karas Dwarf Shrubland of the Nama Karoo biome. A total of 113 bird species have been recorded from 41 survey visits to the nine quarter degree squares through which this section of the proposed transmission line corridor runs. Of these, eight species are listed as "Threatened" or "Near Threatened" in Namibia's Red Data book. No birds along this section are endemic to Namibia although 41 species are endemic to the south-west arid zoo-geographic region of southern Africa with eight species have 40% or more of their global population in Namibia.

2. Mariental to Duineveld (about 100 km), through the eastern edge of the Dwarf Shrub Savanna of the Nama Karoo biome. A total of 200 bird species have been recorded from 193 survey visits to the three quarter degree squares through which this section of the proposed transmission line corridor passes. Of these, 12 species are listed as “Threatened” or “Near Threatened”. One species is near endemic to Namibia and 63 species are endemic to the south-west arid zoo-geographic region of southern Africa of which 14 species have 40% or more of their global population in Namibia.
3. Duineveld to near Rehoboth (about 70 km), through the western edge of the Southern Kalahari of the Acacia Tree-and-shrub Savanna biome. A total of 117 bird species have been recorded from 16 survey visits to the three quarter degree squares through which this section of the proposed transmission line corridor passes. Of these, eight species are listed as “Threatened” or “Near Threatened”. No birds along this section are endemic to Namibia, but 33 species are endemic to the south-west arid zoo-geographic region of southern Africa of which 10 species have 40% or more of their global population in Namibia.
4. Rehoboth to Auas (about 85 km), through the Highland Shrubland of the Acacia Tree-and-shrub Savanna biome. A total of 177 bird species have been recorded from 57 survey visits to the four quarter degree squares through which this section of the proposed transmission line corridor passes. Of these, 11 species are listed as “Threatened” or “Near Threatened” in Namibia’s Red Data book. Seven species are near endemic to Namibia and 41 species are endemic to the south-west arid zoo-geographic region of southern Africa of which 12 species have 40% or more of their global population in Namibia.

The field survey investigated the potential risks and impacts faced by these bird species from factors such as collision and electrocution, as well as risks impacts posed by birds to the supply of power. The main avian victims of collision were, as expected, the *Endangered* Ludwig’s Bustard *Neotis ludwigii* and some threatened raptor species.

The Assessment concluded that:

- A high death rate of 0.66 birds/km/yr are killed on power lines in southern Namibia and this is a conservative estimate unadjusted for scavenger removals;
- At these fatality rates, the new 462-km 400 kV transmission line is forecast to kill a minimum of (462 x 0.66 birds/km/year =) 305 birds per year without mitigation,
  - 91% of these (278 bustards and vultures) are expected to be red data birds;
  - 32% higher fatality rate occurs under 400 kV lines than 220kV lines (0.45 birds/km/yr) in southern Namibia;
- Open gravel or grassy habitats in the Dwarf Shrub savannah in the southern sections of the proposed line showed 5-fold higher fatalities of red-data bustards than other habitats, and this should be mitigated;
- The proposed routing also goes through known red-data vulture breeding areas in the *Acacia erioloba* savannah of the Kalahari biome and these should be avoided;
- For these reasons the proposed transmission line route has been revised to avoid impacts on known existing avifauna “hotspots”, (vulture breeding areas south of Rehoboth and the bustard habitat in dwarf shrub savannah) as far as possible;
- NamPower identified a suitable routing option for the transmission line with input from the environmental consultants and relevant specialists. The realignment has served to avoid and reduce potential negative impacts of the proposed Project on sensitive avifaunal areas, such as the (i) vulture breeding areas on the farms Wilderness Rem, Battle and Friesenland, and (ii) the open gravel and grassy plains of Dwarf Savannahs
- By realigning the lines adjacent to the existing 400 kV line and **staggering the pylons** (the tower of one is aligned with the mid-span of the adjacent line) the high bustard fatality rate is expected to be reduced to acceptable levels;

- As such the re-alignment of the proposed power line corridor has already served to avoid and reduce potential negative impacts of the proposed Project on avifauna.
- This Avifauna Assessment considers the potential impacts of constructing and operating (including monitoring and maintaining) the proposed transmission line and its associated infrastructure (e.g. access track) on the avifauna within the 462 km and 500 m wide transmission line corridor, and region.
- The positive impact associated with the construction and operation of the proposed transmission line is that it will constitute the first test of a potentially significant method to reduce bustard deaths where none have previously worked;
- An additional benefit is the bird-friendly routing reduces the length of the line by ~14-16 km (depending on the exact routing);
- The proposed bird-friendly line also occurs further from the Hardap Dam (a major source of waterbirds that may impact the line);
- The negative impacts linked to the proposed Project is that one potential hotspot of Verreaux's Eagle activity near Dordabis cannot be mitigated due to engineering line constraints and a compromise between ideal bird-friendly and NamPower engineering preferences;
- The potential impact of birds on the proposed infrastructure is negligible if the proposed mitigation and management action is strictly adhered to (particularly the staggered pylon alignment adjacent to the existing 400 kV line). Resulting power outages can have major downstream impacts on the national Namibian economy and these can be avoided by avoiding vulture-rich areas
- No negative impacts are foreseen during the construction and operational phases that cannot be mitigated to an acceptable significance.
- Recommended mitigation measures during the construction phase include:
    - Identify all red data species (eagles and vultures) breeding on the power line or trees or cliffs < 100m of the proposed line and avoid disturbance (construction, vegetation clearing or loud noise) in these areas during the winter breeding months (May – August)
- Recommended mitigation measures during the operational phase include:
    - For all adjacent lines where the new line runs parallel to the existing 400 kV line the towers of the new line must be aligned with the mid-span of the adjacent line to be an effective mitigation. This "staggered pylon" approach is predicted to reduce bustard deaths by 45% over un-mitigated lines
    - Avoid all areas of vulture breeding in the Kalahari Savannah habitat south of Rehoboth
    - Where the planned surveys reveal substantial red data bird deaths due to impacts or electrocutions still occur (> 0.3 birds/km/yr) then additional mitigation is required in the form of bird spirals or static or dynamic diverters on the earth wires

Based on the Project information available and the predicted impacts on the avifauna, it is the reasoned opinion of the avifaunal specialist that the proposed Project should be authorised on condition that the stipulated mitigation measures and management actions are implemented. This includes the implementation of the proposed Avi-fauna Monitoring Plan for Pre- and Post-construction.

EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

AVIFAUNAL ASSESSMENT REPORT FOR INPUT INTO THE IMPACT ASSESSMENT REPORT

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APPENDICES

GLOSSARY OF TERMS, DEFINITIONS AND ABBREVIATIONS

Affected Environment	Those parts of the socio-economic and biophysical environment impacted on by development
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternatives sites for development, alternative site layouts, alternative designs, alternative processes and materials.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that are relevant to the decision.
DEA	Directorate of Environmental Affairs
Developer (or Project Proponent)	NamPower
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report; A report describing the process of examining the environmental effects of a development proposal, the expected impacts and the proposed mitigation measures.
EMA	Environmental Management Act of 2007
EMP	Environmental Management Plan: The EMP for the project sets out general instructions that will be included in a contract document for the construction phase of the project. The EMP will ensure the construction activities are undertaken and managed in an environmentally sound and responsible manner.
Environment	Means the surroundings within which humans exist and that are made up of: a. The land, water and atmosphere of the earth. b. Micro-organisms, plant and animal life. c. Any part or combination of a) and b) and the interrelationships among and between them. d. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.
EC	Environmental Commissioner

Environmental Specifications (ES)	Instructions and guidelines for specific construction activities designed to help prevent, reduce and/or control the potential environmental implications of these construction activities.
HVDC	High Voltage Direct Current
I&AP(s)	Interested and Affected Party(s)
MET	Ministry of Environment and Tourism
Method Statement	A written submission by the Contractor to the Project Manager in response to the Specification setting out the plant, materials, labour, timing and method the Contractor proposes using to carry out an activity. The Method Statement shall cover applicable details with regard to: • Construction procedures. • Materials and equipment to be used. • Getting the equipment to and from site. • How the equipment/material will be moved while on site. • How and where material will be stored. • The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or solid material that may occur. • Timing and location of activities. • Compliance/ non-compliance with the Specifications. • Any other information deemed necessary by the Project Manager.
NAD	Namibia's Avifaunal Database
NNF	Namibia Nature Foundation
Project	This refers to all construction activities associated with the proposed activities.
PM	Project Manager: Appointed firm responsible for overall management of the construction phase of the project including the management of all contractors.
Rehabilitation	Rehabilitation is defined as the return of a disturbed area, feature or structure to a state that approximates to the state (where possible) that it was before disruption, or to an improved state.
SS	Substation
TX	Transmission
TXMP	Transmission Master Plan

1 INTRODUCTION

1.1 Background

This independent Avifaunal Study forms part of the full Environmental Impact Assessment (EIA) process (i.e. Screening, Scoping and Impact Assessment phases) undertaken and which the documentation emanating therefrom will be submitted to the competent authority the Environmental Commissioner (EC) of the Directorate of Environmental Affairs: Ministry of Environment and Tourism (MET-DEA), for decision-making. The EIA is being undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966) and the EIA Regulations, 2012.

NamPower proposes to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km. There are two existing transmission lines connecting the two substations, a 400 kV and a 220 kV line. The pylon height will be approximately 40 m and the distance between pylons approximately 500 m.

NamPower's Transmission Master Plan (TXMP) assumes that the proposed Kudu Project will be constructed and come into operation in 2018/2019. The proposed Kokerboom to Auas 400 kV line is part of the Kudu integration solution. The TXMP also shows that without the proposed Kudu Project, this transmission line is required in 2019/2020 based on the last signed-off power supply scenarios.

The proposed transmission power line is for the benefit of the Namibian electricity transmission backbone and Namibian economy as a whole. It does not serve only the specific area where the transmission power line is to be constructed. The expected Namibian electricity load growth together with possible transfer of power northwards, via the Zambezi Link Interconnector High Voltage DC (HVDC) scheme, requires this transmission line to be operational. Also, the number of cases where an outage of the existing 400 kV line can be accommodated (hence relying only on the 220 kV interconnector from South Africa) is becoming less and less each year as the Namibian electricity load grows.

The Environmental Impact Assessment (EIA) assesses the environmental acceptability of constructing, operating and maintaining a power line within a transmission line corridor with a length of approximately 500 km and width of 500 m (250 m from the centre line)

The proposed transmission line will have a final servitude of 80 m width, with 12 m of that being cleared for an access track. The access track will be used to bring in construction materials, as well as being used to access the power line and its associated pylons for maintenance purposes, throughout the infrastructure's life span. Emphasis was placed on the optimisation of route as well as cumulative impacts of two power lines within the study area. The EIA does not include the expansion of either of the two substations.

This Avifaunal Specialist Study considers the impacts of constructing and operating (including maintaining) the proposed transmission line and its associated infrastructure (for example access track) within the approximately 462 km and 500 m wide transmission line corridor.

This Avifaunal Assessment Report has been compiled within the impact assessment phase of the EIA. Its main objective is to present a description of the avifaunal environment, identify potential impacts on the avifauna (birds), assess these impacts, and propose suitable enhancement and mitigation measures.

1.2 Study Objectives

The study's objectives are to present a description of the avifauna in the local area (i.e. receiving environment) and region through which the proposed power line corridor traverses, identify potential impacts on the avifauna during the construction and operational phases of the proposed project, identify potential impacts of the avifauna on the proposed infrastructure, assess impacts, and propose suitable enhancement and mitigation measures.

1.3 Report Content

The content of the Avifaunal Assessment Report is consistent with the requirements for specialist studies as set out in the EMA of 2007 and the EIA Regulations of 2012, and in summary must contain:

- Details and experience of the person who undertook the assessment and prepared the Report.
- Description of the anticipated impacts, and the methods and procedures for mitigating these identified impacts.
- Description of the proposed activity and its alternatives
- Description of the proposed study area and site
- Description of the need and desirability of the proposed project,
- Policy, legal and administrative/ institutional framework
- Methodology used as well as the assumptions and limitations of the study
- Description of and assessment of cumulative impacts
- Assessment of potential environmental impacts
- Suggestion of mitigation measures and management actions to avoid or reduce negative impacts and enhance positive impacts and
- References.

1.4 Details of the Principal Parties

The Project Proponent/ Applicant is NamPower a state utility whose mandate is to produce, transmit and distribute power to its clients, the users of the power.

The EIA process is being managed by Lithon Project Consultants (Pty) Ltd and the appointed EAP is Ms. Jaana-Maria Ball who is a registered Reviewer and Lead Practitioner with the Environmental Assessment Practitioners Association of Namibia (EAPAN). She prepared all the documentation emanating from this process.

This independent Avifaunal Assessment Study was undertaken by Dr. Rob Simmons (Birds and Bats Unlimited Environmental Consultants) to inform the assessment of the potential impacts arising from this proposed development.

The contact details, expertise and experience as well as a Declaration of Independence by these individuals is found at the beginning of this report.

1.4.1 Scope of Work

The scope of work for the Avifaunal Assessment is:

- Compile a list of birds known to occur within the 19 quarter degree (15' x 15') squares through which the proposed Kokerboom to Auas 400 kV transmission line corridor runs, for each of the four vegetation types traversed (see Appendices 1-4), from Namibia's avifaunal database.
- Assess this list in terms of Endemic and Red Data species, and species potentially at risk from electrocution, collision or any other impacts.
- Assess the list in terms of bird species likely to impact on the proposed power line.
- A field visit to assess the proposed route of the power line, paying particular attention to micro-habitat, high-risk collision-prone red data species, sensitive and high-risk areas to birds, potential flight path conflict areas, nesting areas and any potential issues of birds having a negative impact on power transmission.
- Compile the avifaunal component to the Environmental Management Plan (EMP) for both the construction and operational phases, and an Avifaunal Monitoring Plan.
- Submit the Avifaunal Assessment Report and proposals for mitigation measures.

1.5 Study Approach

The proposed transmission line route runs north from the Kokerboom substation near Keetmanshoop to the Auas substation near the Hosea Kutako international airport east of Windhoek. The alignment traverses four different vegetation types of two biomes, over a rainfall gradient ranging from just under 200 mm in the south to about 400 mm in the north. Because of the somewhat different composition and abundance of bird species across this rainfall gradient and in the different vegetation types, the assessment will look at the bird species that occur along the transmission line in each of the four vegetation types as follows:

1. Kokerboom to near Mariental, a distance of about 205 km through Karas Dwarf Shrubland of the Nama Karoo biome, with the line passing through nine quarter degree (15' x 15') squares;
2. Mariental to Duineveld, a distance of about 100 km through the eastern edge of Dwarf Shrub Savanna of the Nama Karoo biome, passing through three quarter degree squares;
3. Duineveld to near Rehoboth, a distance of about 70 km through the western edge of the Southern Kalahari of the Acacia Tree-and-shrub Savanna biome, passing through three squares; and
4. Rehoboth to Auas, a distance of about 85 km through Highland Shrubland of the Acacia Tree-and-shrub Savanna biome, and passing through four squares.

The proposed transmission line passes within ~10 km of the Hardap Dam, the only large artificial impoundment with a significant fish-eating bird population along the proposed route. Wetland birds often perch on nearby power line support structures, making them potentially vulnerable to electrocution, but also causing flash-overs which impact of power supply. Note that the suggested re-routing here doubles the distance to Hardap Dam to ~20 km.

The Tree-and-shrub Savanna supports a number of near endemic birds to Namibia, for which Namibia has primary global responsibility. The Nama Karoo biome provides the core range of a number of large cursorial birds such as Red data bustards and korhaans which are at high risk from power line collision. The *Endangered* Ludwig's Bustard and *Near Threatened* Kori Bustard have recently been listed at threatened in Namibia because of the high incidents of mortality on power lines (Simmons et al. 2015). Other species such as the Secretarybird, Greater Flamingo and large birds of prey (vultures and eagles) could also potentially be impacted. Both biomes support Red Data species which require special conservation attention. For these reasons, an avifaunal assessment is an integral part of any environmental assessment for transmission lines.

This avifaunal assessment has been undertaken in three parts, to align with the main phases of the EIA, as follows:

- A desktop study, using Namibia's "powerlines and birds assessment tool" on the Environmental Information Service established as a NamPower – Namibian Nature Foundation (NNF) partnership, Namibia's Avifaunal Database (NAD), published papers and reports as well as the extensive experience of the consultant on the birds of Namibia, and
- A field visit and existing power line surveys to assess the proposed route of the power line corridor, paying particular attention to micro-habitat, high-risk red data species, sensitive and high-risk areas to birds, potential flight path conflict areas, nesting areas and any potential issues of birds having a negative impact on power transmission.

These two components would allow for route evaluation and provide the necessary information for the EIA.

- The results of the field assessment were then written up and incorporated into the desktop study. This forms the avifaunal assessment for the full EIA. In addition, a section on Mitigation and Management from an avifaunal perspective was prepared, covering the construction and operation of the power line as well as the monitoring requirements, during construction as well as operation.

Impacts were assessed for both the construction and operational phases of the proposed project. Impacts were not assessed for the decommissioning phase. The reason for this is that NamPower rarely decommission any of its transmission power-lines. If decommissioning were to happen it would take place so far in the future (30 years plus) that an assessment of potential impacts at the present time would be premature as the receiving environment would likely to have changed.

This Avifaunal Assessment Report includes:

- A list of bird species recorded for the project area – refer to Appendices 1- 4 of the Avi-faunal Scoping Report compiled by Dr. Chris Brown as well as Table 1, Page 13.
- Endemic, Red Data and migrant species occurring in the area and an assessment of risks – refer to Tables 1 - 3. Page 13 – 14.
- A list of birds known to currently be a problem from the point of view of electrocution and collision with power lines – refer to refer to Appendices 1 and 2.
- Assessment as to whether the proposed development is likely to pose any significant threat to any bird species – taking into account factors such as habitats, breeding areas, flight paths, behaviour, pylon and line design, etc. – refer to Section 4.1, Pages 22 – 23.
- Assessment as to whether and bird species are likely to impact negatively on the power line development – taking the above factors into account – refer to Section 4.1, Page 23 and Section 5, Page 29.
- Proposal for mitigation and management measures that may be necessary, to (a) eliminate or reduce environmental impacts on birds, and (b) eliminate or reduce impacts of birds on power transmission – refer to Section 4, Page 23 – 25 and Section 5, Page 29.
- Presentation of a Monitoring Plan – refer to Section 4.2, Page 24; as well as Annexure G of the Environmental Management Plan for the construction Phase and Annexure G of the Environmental Management Plan for the operational phase.
- Identification of any issues around the avifauna that may require further investigation and/or assessment – refer to Section 5, Page 29.

1.5.1 Methodology

The Avifaunal Assessment was undertaken from July 2017 to August 2018 as follows:

- Review of Namibia's Avifaunal Database (Jarvis 2001), which includes data from the Bird Atlas project, museum specimens, wetland counts, raptor road counts and breeding records.
- Review the Southern African Bird Atlas Project 2 (SABAP2) website (www.sabap2.adu.org.za*)* for specific species, to check on reporting rates and distributions along the power lines.
- Review the "power lines and birds assessment tool" in the Environmental Information Service (www.the-eis.com).
- Review literature sources (e.g. Harrison *et al*. 1997; Hockey *et al.* 2005; Mendelsohn *et al.* 2002; Simmons *et al.* 2015).
- Review the Scoping Report compiled by Dr. Chris Brown (2015).
- Review of extensive unpublished data provided by Mr. John Pallett on power line victims and numbers per kilometre along power lines in southern Namibia.
- Review distribution and habitat of all species of concern that might conceivably occur along the proposed route.
- Review of proposed route on Google Earth to identify terrain/site of potential concern.
- Field assessment of the existing lines and the proposed power line corridor to:
    - look for evidence of collision or electrocution
    - look for evidence of fish-eating birds using the support structures for perching and roosting
    - assess habitat impact from an avifaunal perspective
    - check substations for possible risks
    - carry out an avifaunal survey along 157 km of proposed and existing power line corridors
- Updating of the collision-prone species list for the project area
- Compilation of avifaunal component to the EMP for the construction and operational phases;
- Preparation of the Avifaunal Monitoring Plan.
- Preparation of the Avifauna Assessment Report, and proposals for mitigation measures.

1.5.2 Assumptions and Limitations

The assumptions for the Avifaunal Assessment are:

- That the species recorded in the general area (i.e. the 19 quarter degree squares) of the proposed power line over the past 25 years from some 307 survey visits, plus a site inspection along the power line corridor, provide a comprehensive record of the species that occur in the project area.

The limitations of the Avifaunal Assessment are:

- The bird atlassing visits are not equally spread across the four vegetation types traversed by the proposed power line, e.g. just 16 survey visits to the three quarter degree squares in the Southern Kalahari compared to 193 visits to the three squares of the Dwarf Shrub Savanna with a strong bias to the square in which Mariental and Hardap Dam falls.
- Birds are highly mobile and respond rapidly to changing environmental conditions. Most arid-zone birds are nomadic in nature. They may be absent from areas seasonally or for many years, but very common when conditions are favourable following rains. Therefore, a species potentially at risk from, for example, colliding with a power line, may be considered to be at low risk based on many years of data showing them to be present only marginally or at very low density. However, their numbers may increase dramatically in a high risk area after a period of above average rainfall.
- Despite covering 157 km of surveys in 2017 along existing power lines, this still represents only 34% of the entire 463 km proposed line. Sub-sampling in different habitats was used to attempt to overcome this.
- The line sampling in September 2017 before the main rains (Feb-April) reduced the chances of recording all species that may be present and vulnerable around the power line.

1.6 Policy, Legal and Administrative Framework

This specialist study is focused on sound environmental management practices and is based on national and international best practices, and relevant legislation, policies and guidelines. This includes the following:

- The Constitution of the Republic of Namibia, of 1990
- Nature Conservation Ordinance 4 of 1975
- National Development Plan: Vision for 2030
- Environmental Management Act of 2007
- Environmental Assessment Policy for Sustainable Development and Environmental Conservation 1995
- Convention on Biological Diversity, 1992

The list of applicable legislation provided above is intended to serve as a guideline only and is not exhaustive or inclusive.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

The proposed power line corridor route traverses two biomes and four vegetation types, and crosses a rainfall gradient of about 200 mm, from just under 200 mm in the south to about 400 mm in the north. In the south the transmission line passes through Karas Dwarf Shrubland for about 205 km (Kokerboom to near Mariental) and across the eastern edge of the Dwarf Shrub Savanna for about 142 km (near Mariental to Duineveld), both in the Nama Karoo biome. The topography comprises mainly gravel and rocky undulating plains with low shrubs and grassland. The transmission line then runs along the western edge of the Southern Kalahari for about 43 km (Duineveld to near Rehoboth) and into the Highland Shrubland for about 77 km (Rehoboth to Auas), both in the Acacia Tree-and-shrub Savanna biome. The topography of the Southern Kalahari comprises wind-blown red Kalahari sand forming linear partly vegetated dunes with grassy inter-dune “valleys”. The land rises in the Highland Savanna to about 1,800 m and consists of an undulating highland plateau with mountain ranges rising to over 2,500 m. In the Mariental area the line corridor passes within about 5 km of the Hardap Dam, the only large water body (a man-made impoundment) near the proposed alignment with significant numbers of wetland and fish-eating bird species.

The Nama Karoo and Acacia Tree-and-shrub Savanna biomes provides the core range of a number of large cursorial birds such as bustards, korhaans and vultures which are at high risk from power line collision. The bustards and vultures have recently been listed at threatened in Namibia because of high incidents of mortality on power lines (Simmons *et al.* 2015). Other red data species that could also potentially be impacted, including, eagles and flamingos. Both biomes provide important habitat for many species endemic to the south-west arid zoo-geographic zone of southern Africa, with 14 of these species having 40% or more of their global populations within Namibia. The Highland Shrubland is particularly important for species near-endemic to Namibia. For these reasons, an avifaunal assessment is an integral part of any environmental assessment for transmission lines.

2.1 The Receiving Environment

2.1.1 Avifauna

Within each of the four vegetation types traversed by the proposed transmission line, the following emerged:

1. Karas Dwarf Shrubland of the Nama Karoo biome, Kokerboom to near Mariental (about 205 km, nine quarter degree squares) – 113 bird species from 41 survey visits (Appendix 1). Of these, eight species are listed as “Threatened” or “Near Threatened” in Namibia’s Red Data book (Simmons *et al*. 2015). There were no species endemic to Namibia reported from this section of the proposed line but 41 species are endemic to the south-west arid zoo-geographic zone of southern Africa (Table 1) of which eight species have 40% or more of their global range within Namibia.

Table 1: Number of bird species recorded, Red Data species, Namibian endemic and near-endemic species, and southern African endemics, for the quarter degree (15’ x 15’) squares in the four vegetation types (of two biomes) traversed by the proposed Kokerboom to Auas 400 kV transmission line corridor.								
Section of transmission line	**Approx. distance (km)**	**Biome**	**Vegetation type**	**No. survey visits**	**No. bird species**	**No. Red Data species**	**No. Namibia endemics**	**No. southern African endemics**
Kokerboom to Mariental	205	Nama Karoo	Karas Dwarf Shrubland	41	113	8	0	41
Mariental to Duineveld	142	Nama Karoo	Dwarf Shrub Savanna (eastern edge)	193	200	12	1	63
Duineveld to Rehoboth	43	Acacia Tree-and-shrub Savanna	Southern Kalahari (western edge)	16	117	8	0	33
Rehoboth to Auas	77	Acacia Tree-and-shrub Savanna	Highland Shrubland	57	177	11	7	41

2. Dwarf Shrub Savanna of the Nama Karoo biome, Mariental to Duineveld (about 100 km, three quarter degree squares) – 200 bird species from 193 survey visits (Appendix 2). This large species diversity is influenced by the presence of Hardap Dam and its wetland habitat within an otherwise arid and semi-arid landscape. Twelve species along this section of the proposed line corridor are listed as Threatened or Near Threatened, one species is near-endemic to Namibia and 63 species are endemic to southern Africa of which 14 have 40% or more of the global range within Namibia.
3. Southern Kalahari of the Tree-and-shrub Savanna biome, Duineveld to near Rehoboth (about 43 km, three quarter degree squares) – 117 bird species from 16 survey visits (Appendix 3). This stretch of line has received the least bird survey work, reflected in the recorded species diversity. Eight species along this section of the proposed line are listed as Threatened. There are no Namibian endemic or near-endemic species here but 33 southern African endemics of which 10 species have 40% or more of their global range in Namibia.
4. Highland Savanna of the Tree-and-shrub Savanna biome, near Rehoboth to Auas (about 85 km, four quarter degree squares) – 177 bird species from 57 survey visits (Appendix 4). This section of the proposed line has 11 Threatened and Near Threatened bird species, six species near-endemic to Namibia and 41 southern African endemics of which 12 species have 40% or more of their global range in Namibia.

In total 16 species of Threatened and Near Threatened birds have been recorded in the vicinity of the proposed transmission line (Table 2), one Critically Endangered species, six Endangered, four Vulnerable and five Near Threatened species.

Table 2: The local status of Red Data bird species in different sections of the proposed Kokerboom to Auas 400 kV transmission line corridor					
Red Data Category	**Species**	**Red Data bird status in the Kokerboom to Auas corridor**			
		Kokerboom to Mariental	**Mariental to Duneveld**	**Duineveld to Rehoboth**	**Rehoboth to Auas**
Critically Endangered	Cape Vulture	-	Rare	-	-
Endangered	White-backed Vulture	Uncommon	Uncommon	Common	Uncommon
	Tawny Eagle	-	Rare	Rare	Uncommon
	Booted Eagle	Rare	Uncommon	-	-
	Martial Eagle	Uncommon	Uncommon	Uncommon	Rare
	Black Harrier	-	Rare	-	Rare
	Violet Wood-Hoopoe	-	-	-	Rare
Vulnerable	Greater Flamingo	-		Rare	-
	Ludwig's Bustard	Rare	Uncommon	-	-
	Secretarybird	Uncommon	Rare	Uncommon	Uncommon
	Lappet-faced Vulture	Rare	Rare	Common	Uncommon
Near Threatened	Marabou Stork	-	-	Rare	Rare
	Verreaux's Eagle	Common	Uncommon	-	Uncommon
	Kori Bustard	Common	Uncommon	-	Rare
	Rüppell's Parrot	-	-	Common	Uncommon
	Sclater's Lark	-	Rare	-	-

Seven near endemic bird species have been recorded in the vicinity of the proposed line (Table 3), all occurring in the section of through the Highland Savanna vegetation type and only one being recorded from Dwarf Shrub Savanna.

Table 3: The local status of endemic and near endemic birds to Namibia in different sections of the proposed Kokerboom to Auas 400 kV transmission line corridor.				
Species	**Kokerboom to Mariental**	**Mariental to Duneveld**	**Duineveld to Rehoboth**	**Rehoboth to Auas**
Rüppell's Parrot	-	-	-	Uncommon
Violet Wood-Hoopoe	-	-	-	Rare
Damara Hornbill	-	Rare	-	Rare
Monteiro's Hornbill	-	-	-	Rare
Carp's Tit	-	-	-	Rare
Rockrunner	-	-	-	Uncommon
White-tailed Shrike	-	-	-	Uncommon

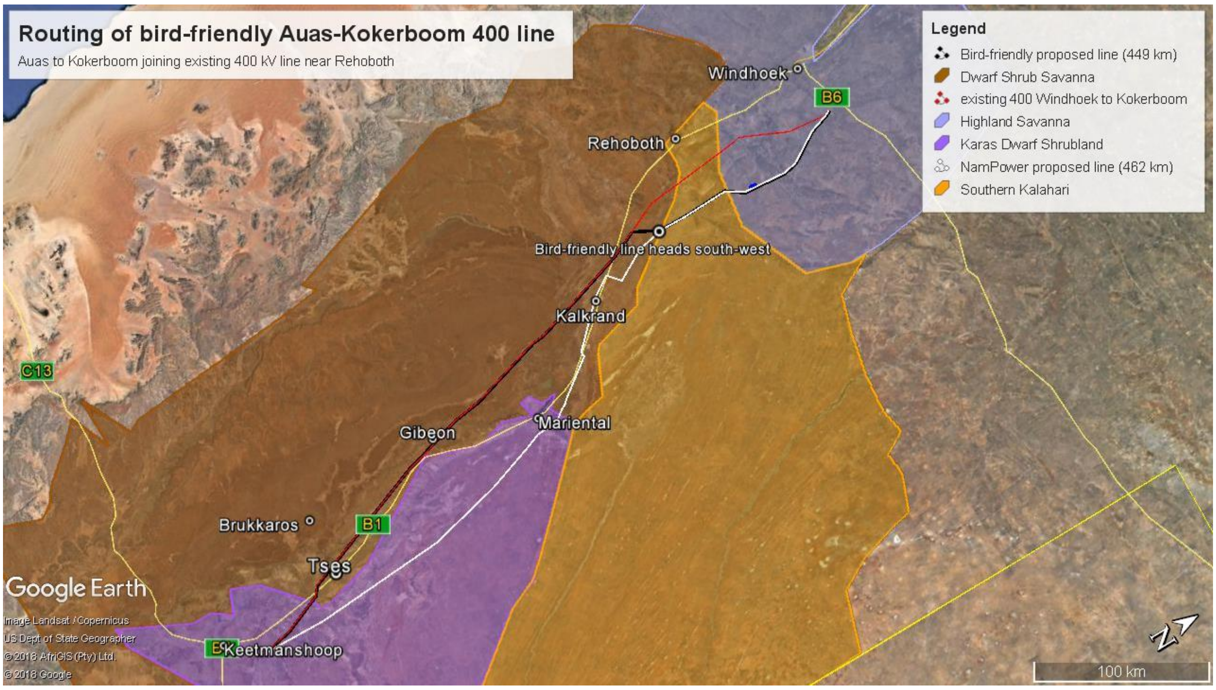
3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1 Overview

NamPower proposes to construct a single-circuit 400kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 462 km. There are an existing 400 kV and a 220 kV transmission line connecting the two substations but these follow a different route. The final transmission line servitude will be 80m wide, with 12m of that being cleared for an access track.

The proposed transmission line corridor alignment runs south from the Kokerboom Substation and then parallel to the 220 kV transmission power line from Kalkrand southwards. It will exit the existing Kokerboom Substation in a southerly direction and enter the existing Auas Substation from the north (**Figure 3.1**).

Figure 3-1: Locality Plan indicating the proposed bird-friendly alignment of the Kokerboom – Auas Transmission Line. The line follows the NamPower routing in the northern sections and then joins and parallels the existing 400 kV line near Kalkrand south to Kokerboom.



The proposed transmission power line traverses 3 regions, namely Khomas, Hardap and //Karas.

The infrastructure proposed includes a 400 kV transmission line conductor strung onto 45 m high steel pylons, of the Open-V or the Self-Supporting design, placed approximately 500 m apart. These pylons will be placed on a 10 m by 10 m concrete base. The line needs to be at least 100 m away from the 400 kV power line.

The proposed construction work to be carried out includes:

- site establishment, including site demarcation and fencing (temporary and only where required), layout and establishment of the contractor's camps including ablution and cooking facilities (this will only be established if required by the appointed Contractor);
- digging of holes for the concrete pylon base;
- casting of concrete platforms for the pylons;
- transportation of plant, machinery and equipment to site;
- transport of the conductor into position by means of a pulley system or by rolling large coils of conductor into position;
- hoisting and lifting of the pylons into position;
- stringing of the conductor; and
- construction of the access road.

The transmission power line will take approximately 24 months to construct, depending on whether one or more Contractors are appointed to undertake the work and/ or there are one or more working fronts. Most experienced contractors can string the lines at a rate of approximately 6 km/ day so the work will proceed along the line relatively quickly. Each farmer will be 'disturbed' intermittently for a period of 6 to 8 weeks during the construction period. This period would depend on the length of power line on each farm.

If Environmental Clearance is granted and prior to construction, NamPower will approach each one of the potentially affected farmers with the view of negotiating use of an 80 m wide 'right of way' servitude over the affected properties for the purpose of constructing and operating the proposed transmission line. Negotiations will include access requirements (including gates), which will be locked at all times; keys will be provided to both parties. Infrequent access will be required (approximately every 3 years). A final 'walkdown' of the proposed centreline of the transmission power line corridor alignment will be undertaken and the sites of each of the pylons finalised and demarcated. During final positioning of the pylons, sensitive features (e.g. plant habitats and archaeological sites) will be avoided.

An Environmental Management Plan (EMP) for the construction and operational phase will be compiled. They will be included in the tender documentation and the Contract with the appointed Contractor(s). It will contain all mitigation measures/ management actions proposed in this EIA process and will be included in draft format in the Assessment Report.

NamPower has operated the existing 400kV and 220kV transmission power lines between the Kokerboom and Auas Substations for the past 16 and 17 years, respectively.

The operation of the power line will be a continuation of the *status quo* operational and maintenance activities, namely:

- site inspections, including Technical and Safety, Health, Environment and Wellness (SHEW);
- power line housekeeping;
- vegetation management, including herbicide application and manual vegetation clearing; and
- maintenance of the powerline and repair of the access roads.

Specific details regarding the construction process, number and type of employees, worker accommodation and procurement will only be determined once an EPC contractor is appointed. In the interim, it is expected that most construction phase workers will require specialised technical skills; there will be some unskilled work available to local residents (estimated to be 10% of the total construction phase workforce) and indirect economic opportunities (e.g. sale of food, cleaning, and accommodation). During the operational phase, there will be few additional employment opportunities as the existing team will extend the scope of their tasks to include the maintenance and management of the proposed 400 kV line.

The above construction and operational activities formed the development 'proposal' (referred to as the proposed Project) as assessed in the EIA process.

3.2 Alternatives

A number of alternatives ('no-go', technology, methods of construction and operation, equipment, and mitigation measures) to the construction and operation of the transmission power line were considered by NamPower and assessed during the EIA process.

The 'no-go' alternative is not recommended given the importance of the Kokerboom to Auas transmission line in power supply to Namibia. The demand for power is continually increasing as a result of population expansion, diminishing power supply from Namibia's neighbouring countries, as well as residential, mining, agricultural and industrial development. The existing 400kV and 220kV power lines cannot cope with the expected power transmission requirements into the future. A new line is currently predicted to be needed to come on line with the overall transmission line system within the next 5 to 10 years. Should the Kudu Gas Project come on line earlier than expected then the transmission power line will be required earlier.

Three alternative power line corridors were assessed during the Scoping Assessment. Each alternative was scoped and a new alternative put forward for assessment that avoided potential negative biophysical and socio-economic impacts. The power line corridor is 250m either side of the proposed centre line.

The technical specialists although involved in the scoping of the power line corridor alternatives assessed the ‘favoured’ alternative corridor in detail. The preferred corridor alignment avoided sensitive environmental features, most notably sensitive perennial pans and an avifauna hotspot and social infrastructure such as landing strips, recreational areas, homesteads, tourist lodges, towns, villages etc.

As discussed in the Avifauna Scoping Report, the preferred alternative from an avifaunal perspective would be to align the proposed 400 kV transmission line as close as possible to the existing 400 kV line. Because most bird strikes take place with conductors and earth wires between the towers – usually mid-span, the ideal configuration would be to place the towers of the proposed line about mid-way between the towers of the existing line. Thus, the towers of each line would help mitigate bird strike on the respective adjacent line. This new mitigation measure arises because extensive research shows that bustards (the main collision victim) hit the towers about 10% and thus seem to avoid them. Thus, by aligning the tower of one line with the mid-span of the adjacent line, bustard fatalities could be reduced > 50%.This may make a significant contribution to reducing bird strikes on both lines.

Figure 3-2: An example of staggered pylons on adjacent power lines – the new mitigation measure that is expected to reduce threatened bustard deaths by > 50%.

For this mitigation to be fully effective, and at the same time take cognizance of the engineering limitations conveyed in discussion with Nampower staff, we propose that from the Auas substation it follows the Nampower routing via Dordabis and south towards Kalkrand. Approximately 43 km north of Kalkrand, vulture breeding areas are encountered and we suggest the proposed line deviates south west from the proposed route at S23°37'23.16" E 17°26'32.99" and joins the existing 400 kV line at S23°44'36.60" E 17°22'10.26”. From here the bird-friendly line runs for ~312 km adjacent to the existing 400 kV line, with pylons staggered as described above to reduce bustard mortalities. This routing is 14-16 km shorter than the Nampower-proposed line to the east.

Discussions with farmers along the NamPower-proposed routing found that they were not happy for a new power line corridor to traverse their farms and several cited as reasons the visual aspects of the wild game farm will be compromised, and they feared the possibility of collisions by the breeding vultures and bustards on their properties.

The proposed corridor for the transmission power line as described above will remain the same. It is further proposed that the proposed “new” centreline be walked by the specialist prior to construction to locate preferred detailed positioning of the pylons and specific details about their structure.

In sourcing the specific equipment for the proposed transmission line project, NamPower will assess alternatives in terms of availability, efficiency, compatibility with the existing equipment, cost and environmental sustainability, before making a final decision.

Operational alternatives are limited as NamPower already has an operational protocol for the 400kV and 220kV power lines between the Kokerboom and Auas Substations, as well as its other transmission lines, which are being implemented satisfactorily. Operational procedures will be a continuation of the *status quo,* as new operational procedures are considered unnecessary by NamPower given that the current ones are tried and tested and considered effective, efficient and sustainable.

4 POTENTIAL IMPACTS

NamPower identified the transmission line corridor alignment in consultation with the specialists and directly affected land owners, key stakeholders, and with input from the environmental consultants, relevant specialists and registered Interested and Affected Parties. The screening of corridor alignments, the development of a “preferred” alignment alongside the existing powerline has already served to avoid and reduce potential negative impacts of the proposed project on the avifaunal receiving environment.

The potential impacts of the proposed development are estimated on the basis of available data from long-term bird monitoring projects and from experience of impacts from other power lines. The field survey investigated these aspects in relation to the bird species expected to occur in the project area.

The potential impacts of the proposed development are estimated on the basis of available data from long-term bird monitoring projects and from experience of impacts from other power lines. The main impacts of power lines on birds are:

- Birds colliding with the lines, e.g. large cursorial birds such as bustards, wetland birds, e.g. flamingos, and birds of prey, mainly vultures and large eagles – all species with low reproductive rates;
- Birds being electrocuted on the lines, usually on the towers, and mainly impacting large slow-breeding species;
- Degradation of breeding and/or feeding habitat.

The main impacts of birds on power lines are:

- Birds causing short-circuits (flash-overs) and potential power outages and damage to equipment. This can happen when birds are electrocuted, when large raptorial birds perch above insulators and defecate over insulators, and birds build nests in support towers which may cause short circuits, particularly after rain, and catch fire causing damage to infrastructure.

It is not expected that there will be long-term cumulative impacts of the power line, and their associated access tracks, running alongside each other on the avifauna.

Mitigation measures consider the design of the infrastructure to reduce the risk of electrocution and collision of birds, as well as the timing of the construction period, and make the infrastructure less attractive as perches and for nesting.

4.1 Identification of Potential Impacts

The potential impacts of the proposed project on the avifauna of the receiving environment are described in terms of the following criteria:

a) Nature of the impact
b) Extent of the impact
c) Duration of the impact
d) Intensity
e) Reversibility
f) Irreplaceability
g) Consequence
h) Probability of occurrence
i) Significance
j) Degree of confidence in predictions
k) Cumulative impacts.

The impacts will be further evaluated in accordance with the rating tables provided in **Section 4.3**.

4.1.1 Construction Phase

Habitat degradation that might be detrimental to bird breeding or feeding conditions. That is, clearing of the servitude and corridors will impact and disturb some sensitive species, and open up corridors for predators (avian and mammalian) that may not otherwise occur there.

Disturbance in the form of labourers, machinery and noise is the biggest impact to birds, during construction, particularly large breeding birds that use traditional nest sites on cliffs, large trees or pylon towers.

4.1.2 Operational Phase

Collision by birds with power lines. There are a number of species that are particularly vulnerable to power line collision, to the extent that they are now considered threatened specifically because of high mortality rates from power line collisions resulting in declining populations (e.g. the bustards: Shaw et al. 2015). This is the most important environmental issues from the perspective of avifaunal conservation and power lines.

Electrocution of birds, mainly large species on support towers. This threat has largely been eliminated in the design of modern support structures.

Disturbance and destruction of nests during inspection and maintenance, mainly relevant to threatened species breeding on the support structures.

Short-circuits caused by birds as a result of direct electrocution, defecation on insulators (mainly by large raptors and colonial, fish-eating birds where power lines pass close to large water bodies) and building nests which may cause flash-overs, particularly when wet from rain, and which may catch fire.

4.1.3 Cumulative impacts

Every additional power line constructed poses an additional threat, particularly to species vulnerable to collision. The more spread-out across the landscape are the power lines, the greater the threat. Bundling transmission lines as closely as possible reduces the geographic footprint and thus the exposure of a larger part of the populations of vulnerable bird species to risk.
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4.2 Mitigation of Impacts

The transmission line route has already been altered to avoid potential environmental impacts. NamPower identified suitable routing options for the transmission line in consultation with a range of personnel from NamPower, and with input from the environmental consultants and relevant specialists. The realignment has already served to avoid and reduce potential negative impacts of the proposed project on avifauna and other environmentally sensitive areas/ receptors.

Mitigation will strive to achieve the following:

- Rectification: impact is mitigated after it has occurred e.g. rehabilitation of areas disturbed by construction and rehabilitation of eroded areas
- Compensation: providing a substitute resource for a resource that has been lost because of the project e.g. “ offsets”
- No action (least preferred) and
- Enhancement: establish optimisation measures that will enhance the benefits of the positive impacts.

Avifaunal mitigation measures for power lines typically focus on (a) alignment to avoid potential risk areas, (b) means to limit habitat degradation, (c) avoidance of disturbance during the winter breeding season of large raptors and vultures (d) ways to reduce birds colliding with lines, (e) avoid electrocution and (f) reduce the likelihood of flash-overs that may cause power disruptions and damage to equipment. In addition, the Environmental Management Plan usually requires a level of monitoring that would reveal any unanticipated impacts.

As indicated above, the alignment selected by the EIA Team and NamPower is the most appropriate one from an avifaunal perspective, being as close as practical to the existing line for part of its route.

If collision is still found to be a significant risk, then line markers (e.g. flappers) may be considered for high risk areas. The design of the towers, insulators and line configuration is important to avoid electrocution. Fitting perch dissuaders (e.g. wire brushes) above insulators or providing alternative perch sites have been used where birds foul insulators, causing short circuits. These possible mitigation approaches will be considered if due justification is found from the field assessment.

The issue of birds colliding with power lines is usually significantly more important than the other potential impacts. Reducing the extent of collision is usually best approached by (a) aligning the power line to avoid the proximity of wetlands and bird flight paths, as well as habitat that supports high populations of vulnerable species. In the case of perhaps the most vulnerable species in the area of the proposed Kokerboom to Auas 400kV transmission line, Ludwig's Bustard, Kori Bustard and White-backed Vulture, the gently undulating sparsely vegetated Nama karoo shrub and semi-arid gravel and sandy plains of the savanna biomes in the south, and the *Acacia erioloba* savannah in the Kalahari biome in the ephemeral drainage lines north of Kalkrand would be expected to support larger populations of these high-risk species than the more broken, rocky and hilly terrain to the west of the road; (b) bundling power lines as closely together as possible, to reduce the geographic impact across the population distribution of high-risk species; (c) where an existing line of the same type (e.g. an existing 400 kV line of the same configuration) exists, aligning the proposed new line as closely as possible to this, so that the line and tower heights are approximately the same, and (d) adjusting the distribution of the support towers of the proposed new transmission line to fall approximately mid-way between the support structures of the existing line (= staggered pylon mitigation). This could increase the visibility of both lines, each mitigating potential mid-line collision of the other, and may have a significant impact on reducing the incidents of collision on both lines. Theoretically it would reduce collisions by 45% for both the new and the existing lines. It may also reduce the need for the use of line markers; and (e) if, after field assessment, collision is considered to be a significant risk in sections of the line, then line markers (e.g. spiral and flappers) may be considered for high risk areas.

The design of the towers, insulators and line configuration is important to avoid electrocution. Fitting perch dissuaders (e.g. wire brushes) above insulators or providing alternative perch sites have been used where birds foul insulators, causing short circuits. These possible mitigation approaches will be considered if due justification is found from the field assessment.

In summary the proposed mitigation measures for implementation during the construction phase to reduce potential negative impacts are the following:

- Work on construction to be undertaken outside the winter breeding months where large vulture or raptors are found breeding < 100 m from the line
- Avoiding large tree nests or cliffs where raptors or vultures are breeding
- Reducing the possibility of hunting, trapping or wilfully disturbing threatened red data birds, especially those breeding close to the line corridor

In summary the proposed mitigation measures for implementation during the operational phase to reduce potential negative impacts are the following:

- Avoid the high risk areas identified in the avian assessment, particularly north of Kalkrand where vultures feed and breed in the Kalahari biome (starting at S23°44'47" E 17°28' 04")
- Follow the routing of the existing 400 kV line for as far as possible south of Rehoboth
- To stagger the pylons of the two adjacent 400 kV lines such that the tower of one is aligned approximately with the mid-span of the adjacent line
- Where high fatalities continue to occur bird diverters (spirals or flappers) should be attached to the earth wire

These mitigation measures are to be incorporated in the project Environmental Management Plans (EMPs) for the construction and operational phases, and applied as necessary.

The following monitoring is recommended with respect to the avifauna (refer to **Annexure G of the EMP for the construction phase** and **Annexure G of the EMP for the operation phase** for further detail):

- All bird mortalities should be reported during the construction phase.
- The baseline monitoring of priority species abundance, started in various sections of line in September 2017 should continue along the same lengths of line to gather abundance data for the remainder of the seasons.
- Monitoring of maintenance personnel and vehicles must be undertaken by supervisors to ensure that no unnecessary disturbance takes place in areas where threatened species may be breeding;
- Post-construction monitoring should be implemented to assess the impact of displacement, particularly on priority species.
- Post-construction monitoring should include site visits every 3-months for the first 12 months after construction to pre-determined-lengths of line in all (4) habitats to determine collision rates and fatality hot spots per km of line. If collision rates indicate high mortality levels, further mitigation measures must be considered.
- Thereafter, the frequency for further monitoring will be informed by the results of the initial 12-month period.
- Where raptor or vulture nests are discovered < 100m from the line, their breeding success should be monitored approximately every 1.5 months through to fledging.

4.3 Impact Rating Tables

A rating table has been completed for each identified impact in each phase of the proposed project lifetime, without and with effective mitigation measures in place.

The table overleaf outlines predicted environmental impacts on the avifauna during the construction phase.

Table 4.1: Construction Phase Impacts Without and With Mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Avian impacts:										
Impact Description: Generally negative given that areas within 100 m of the line corridor used for feeding, roosting and breeding will be disturbed. Disturbance can take the form of people presence (keeping red data birds away from nests) vehicle presence (keeping birds away from feeding, breeding or roosting areas) and noise disturbance (frightening red data birds from nests or displacing them from the area in general). At worst, red data birds may be poisoned or hunted by labourers employed on site, seeking to supplement their diet or income. Once construction is over birds may return within 12 months. The magnitude (intensity) is likely to be low as few red data birds are likely to be breeding within a few km of the line if the alignment suggested is taken up. If birds return then the impact is reversible, unless human settlements or traffic increases along the servitude. The probability of this occurring is medium and the confidence in these predictions is medium given the published research on disturbance to breeding birds										
Without Mitigation	negative	Regional	Short term	low	low	low	Short term but reversible	Medium	Mod erate	Medi um
Mitigation Description: Avoid disturbance during the winter breeding season by limiting noise, vehicle access and people traffic < 100 m of any red data species nests Ensure that labourers do not trap, shoot, poison or wilfully disturb any birds in the vicinity of the line										
With Mitigation	Reduced negative	Regional	Short term	low	low	low	Short term but reversible	Medium	Low	Medi um
Cumulative Impact: Single Power line construction, on its own, has a low impact on biodiversity in an area and it is generally of short term duration. Where the power line corridor and servitude alters the landscape and allows new predators (humans, dogs, cats, crows) into an area then longer term changes are likely, Camera trap studies in South Africa's Karoo (Shaw et al. 2015b) indicate numerous predators at carcasses under power lines, some of which are not indigenous (feral cats and dogs) and others that may be there due to the pylons (crows). Thus, longer term effects of opening up new corridors are apparent on the biodiversity in such areas.										

The table below outlines predicted environmental impacts on the avifauna during the operational phase.

Table 4.2: Operational Phase Impacts Without and With Mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Avian impacts:										
Impact Description: Birds are negatively impacted by power lines and associated infrastructure in two main ways: direct impact on the earth wires or conductors (rarely on the towers) and by electrocution. They may cause flash-overs when streamers from defecation span an air -gap causing a short circuit and short-term power outage down the line. One positive impact for the birds is that for some species, especially tree-nesting raptors, pylons provide perch and nesting sites where none existed previously										
Without Mitigation	Negative	Regional	Long-term	High	low	High	Reduced population size of bustards and other red data birds	High	High	High
Mitigation Description: Avoid routing the new line through all areas identified as high risk in the avian assessment. Two of the main areas are (i) the vulture feeding and breeding areas in Kalahari Sand savannah north of Kalkrand and (ii) the high bustard mortality areas in the open grassy and gravel plains of the dwarf shrub savanna south of Kalkrand. The high avian mortality rates in the Dwarf Shrub savanna are best mitigated for the collision-prone bustards by aligning the proposed line adjacent to the existing 400 kV line from Kalkrand south and staggering the pylons. This is predicted to reduce the estimate high mortality of 300 bustards per year by at least 50%.										
With Mitigation	Negative	Regional	Long-term	Medium	low	Medium	Reduced population size of bustards and other red data birds	High	Medium	Medium
Cumulative Impact: Thousands of kilometres of high voltage power lines criss-cross Namibia and South Africa and red data birds such as bustards, cranes, and vultures are killed and less-often electrocuted on these lines. Including those killed on the smaller reticulation lines 46 000 bustards are estimated to be killed annually in South Africa (Shaw et al. 2015a) and similar figures are likely for Namibia. This is causing population declines. Thus, there are wide-spread and far-reaching cumulative effects for the collision-prone red data species in southern Africa and the staggered pylon mitigation may be the most effective means of reducing this exceptionally high mortality rate.										

5 CONCLUSIONS AND RECOMMENDATIONS

Over 200 bird species were recorded from 207 survey visits to the nineteen quarter degree (15’ x 15’) squares traversed by the proposed 400 kV transmission line from Kokerboom near Keetmanshoop to Auas near Windhoek, drawn from information contained in Namibia’s Avifaunal Database. The avifaunal assemblages were assessed for each of the four vegetation types through which the line is expected to pass. The number of Threatened and Near Threatened Red Data species range from 8-12 for the four vegetation types while species endemic and near-endemic to Namibia are confined mainly to the northern section of the transmission line in the Highland Shrubland vegetation, between Rehoboth and Auas. The number of birds endemic to the south-west arid zoo-geographic zone of southern Africa range from 33 to 63 with 14 species having 40% or more of their global populations within Namibia.

Power lines across the Karoo and semi-arid Tree-and-shrub Savanna biomes, in both Namibia and South Africa, have been shown to have a significant impact on some bird species, mainly as a result of birds flying into the lines. Ludwig’s Bustard, Kori Bustard and White-backed Vulture are all listed as Threatened Red Data species. In the case of the bustards, the main cause of mortality appears to be power line collisions, resulting in significant population declines. For a number of other large Red Data bird species such as flamingos, other vultures and eagles, power line collision is an important contributing factor to the level of threat that they face. Effective and cost-efficient mitigating measures to power line collision are proving to be elusive, and the current best practice approach is to bundle lines as closely as possible, avoid high risk areas and deploy line markers.

Namibian power lines kill on average 0.66 birds/km/year and rates adjusted for scavenger removal of carcasses are estimated to be in excess of 1.0 birds/km/year. At these rates an unmitigated power line of this length (~462 km) will kill a minimum of 305 birds per year of which > 90% will be red data bustards. Thus, every effort should be made to reduce this high fatality rate.

This Avifaunal Assessment concluded that:

- The transmission line proposed centreline has been revised to avoid impacts on known existing avian “hotspots”, as far as possible. NamPower identified a suitable routing option for the transmission line with input from the environmental consultants and relevant specialists. The realignment has served to avoid and reduce potential negative impacts of the proposed Project on sensitive avifaunal areas, such as the vultures breeding north of Kalkrand and the bustards migrating into and out of the Dwarf Shrub Savanna in southern Namibia. As such the re-alignment of the proposed power line corridor has already served to avoid and reduce potential negative impacts of the proposed Project on avifauna.
- This Avifauna Assessment considers the potential impacts of constructing and operating (including monitoring and maintaining) the proposed transmission line

and its associated infrastructure (e.g. access track) on the avifauna within the 462 km and 500 m wide transmission line corridor, and region.

- The positive impact associated with the construction and operation of the proposed transmission line is that towers can sometimes provide nesting sites for species that may not other-wise breed in a tree-less environment.
- The use of brushes and other diverters to prevent birds from perching over and defecating on insulators will avoid power supply interruptions.
- The construction of the staggered pylon alignment will be the first such test of this new mitigation in southern Africa and if it successfully reduces collision fatalities then the idea can be rolled out to other power utilities such as Eskom in South Africa. Ongoing monitoring will evaluate its success and determine if further mitigation is necessary.
- The negative impacts linked to the proposed Project is that hundreds of Red Data bustards are likely to die flying into the lines and earth wires.
- The potential impact of birds on the proposed infrastructure will be greatly reduced if the proposed mitigation and management action is implemented. Without mitigation the impact on the cost of repairs to pylons can be significant. Resulting power outages can have major downstream impacts on the national Namibian economy.
- No negative impacts are foreseen during the construction and operational phases that cannot be mitigated to an acceptable significance.
- Recommended mitigation measures during the construction phase include:
    - Avoiding human disturbance near breeding red data species especially during the winter breeding months
    - Reducing trapping and other wilful interference of such species
    - Implementation of the proposed Avi-fauna Monitoring Plan
- Recommended mitigation measures during the operational phase include:
    - Regularly and systematically monitoring the lines for fatalities to identify hotspots that can then be further mitigated with spirals and other bird diverters. As laid out in Annexure G (Monitoring plan) this should occur every 3 months (i.e. after an initial "clearing" survey along 30 km sections, the first full survey should occur 3 months and then 6 months after the clearing, covering the wet season)
    - Implementation of the proposed Avi-fauna Monitoring Plan

Based on the Project information available and the predicted impacts on the avifauna, it is the reasoned opinion of the avifaunal specialist that the proposed Project should be authorised on condition that the stipulated mitigation measures and management actions are implemented.

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Appendix 1: All avian power line fatalities and live collision-prone species recorded in similar habitat close to the proposed line, 12-20 September 2017. The proposed line is differentiated from sections of existing lines.

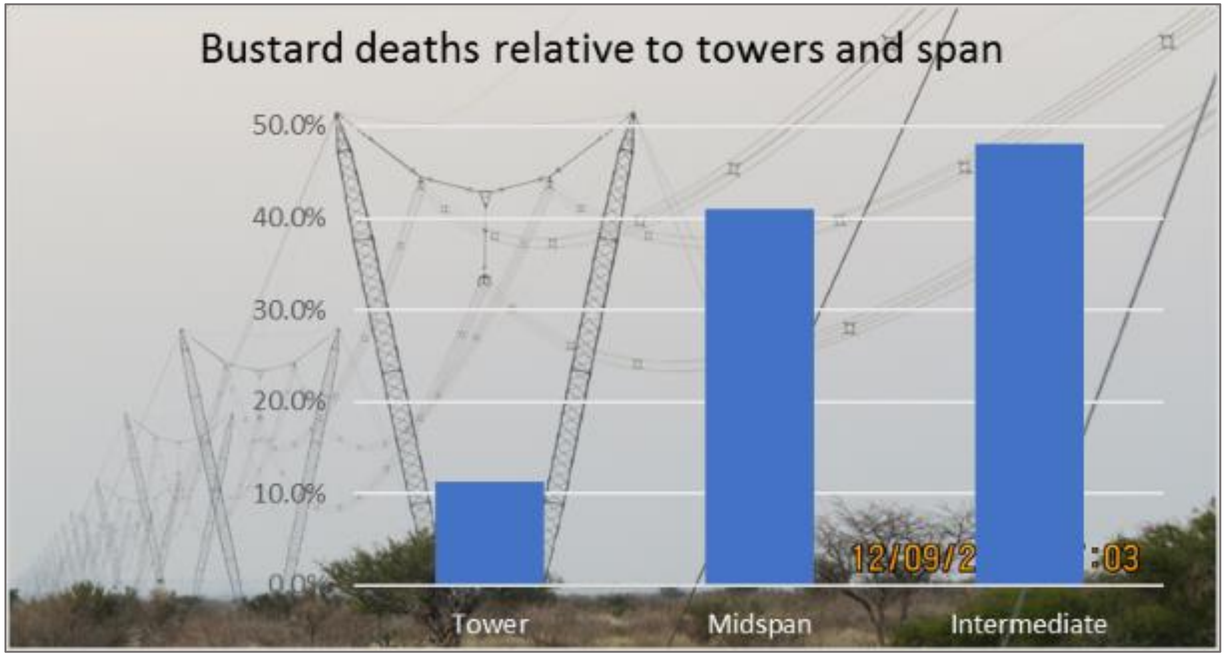
Date 2017	Area and habitat	Line	Distance surveyed (km)	Habitat	Bird carcasses (Species)	Live CPS* (Species)
12-Sep		400	1.4	Thicket farmland	0	
12-Sep		400	3.2	Thicket farmland	0	
12-Sep	Tses	400	18	Thicket	0	
12-Sep		**220**	4.2	Open gravel with grasses	1 (Kori Bustard)	3 (Kori Bustard)
					1 (Bustard species)	2 (PCG)
13-Sep	Mariental	400	20	Thicket + grass	0	8 (PCGx6, Sandgrouse x 2)
13-Sep	Mariental	**220**	17.85	Mixed thornbush + open spaces	2 (Kori Bustard)	1 (Verreaux's Eagle)
					1 (Bustard sp)	
14-Sep	Kalkrand	400	20	Mixed open and thicket	5 (Bustard sp)	2 (B chested Snake-E, WB Vulture)
14-Sep	Kalkrand	**220**	20	Mixed thicket and open	1 (Kori Bustard)	
14-Sep	D1230	**proposed**		Kalahari woodland	N/A	6 (WB Vultures, soaring), 100+ vultures reported breeding
15-Sep	Rehoboth (east)	400	20	Thicket on Kalahari Sands	1 (Bustard)	
						WB Vultures x28 on 66kV
16-Sep	KlipVlei farmland	**proposed**	3.7	Thicket farmland	N/A	3 (Black-chested Snake Eagle)
	KlipVlei farmland	**proposed**	10	Thicket on Klipvlei	N/A	Up to 100 vultures reported on this and surrounding game farms
18-Sep	Khomas Hochland	400	20	Thicket	1 (Ludwig's Bustard)	
18-Sep	Khomas Hochland	220	12.9	Thicket - very dense in places	0	2 (Brown Snake E pair)
20-Sep	Dordabis	**proposed**	20.1	Thicket + riverlines + Poort	N/A	2 (Verreaux's Eagle nests)
	Dordabis	**proposed**	7.3			1 (Augur Buzzard)
	Dordabis	**proposed**	9			

Summary: 13 fatalities (all bustards) found under 157 km of existing transmission lines.
400 kV lines: 8 fatalities in 102.6 km = 0.08 fatalities/km/yr
220 kV lines: 5 fatalities in 55 .0 km = 0.09 fatalities/km/yr (little fatality difference between lines)

Habitat: Open grassy: 10 fatalities in 62 km of open grassy or mixed open-thornveld = 0.16 fatalities/km/yr
Thicket or wooded: 3 fatalities in 95.6 km of bush-encroached or thornveld = 0.03 fatalities/km/yr Open grassy areas 5-fold higher fatalities than thicket

Appendix 2: Bustard fatalities in relation to span and towers in Namibia.

Records combine those for southern Namibia (J. Pallett unpubl data N = 102) and the Auas-Kokerboom power line (this study, N = 13) and indicate that the majority of bustard deaths occur away from the towers themselves (89%). This has implications for possible mitigations.



PROPOSED KOKERBOOM – AUAS 400 KV TRANSMISSION LINE

AVIAN ENVIRONMENTAL IMPACT ASSESSMENT - AMENDMENT

Prepared for:

NamPower
Powering the Nation and beyond

Prepared by:

BIRDS & BATS UNLIMITED
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1. BACKGROUND

In September 2017, Birds & Bats Unlimited (BBU 2017) were commissioned by Lithon Environmental (Pty) Ltd to survey the proposed NamPower 462-km line from Kokerboom (Near Keetmanshoop) to Auas (near Windhoek) to determine and mitigate impacts from birds along the newly proposed 400 kV line.

Surveys along existing transmission lines in the form of a 400 kV line running mainly to the west of the B1 motorway, and a 220 kV line close to the preferred proposal were sampled for power line victims (dead birds) in 2017. These data were combined with long-term data provided by J Pallett to provide a picture of the high and medium risk areas along the proposed routing and along the existing lines.

The **initial** findings and recommendations (BBU 2017) were that:

(i) the proposed line is best run parallel with the existing 400 kV line west of the B1 and
(ii) the pylons are staggered such that the tower of one line, aligns with the mid-span of the adjacent line;
(iii) this could reduce bustard deaths by 50% as these highly collision-prone species tend to avoid pylon towers but regularly hit the mid-span areas.
(iv) The proposed routing avoids high vulture activity and breeding sites north of Kalkrand

Subsequent discussions and considerations of technical difficulties with NamPower officials and planners, and avian specialists Dr Chris Brown and Dr Ann Scott and Mike Scott and compromises on (lower) tower height for the proposed 400 kV have resulted in the following changes to the conclusions of the BBU (2017). This document explains those amendments as an update to the original avian assessment.

The **amended proposals** for the routing are as follows:

(i) Overall, the routing will follow the existing 220 kV line from Auas to Kokerboom for the majority of its length;
(ii) The new 400kV line will employ small pylon support towers to match the height, as far as possible, to that used on the existing 220 kV line
(iii) Throughout the route, the proposed 400kV line must run adjacent to and employ **staggered pylons,** such that the pylons of the proposed 400 kV line align with the midspan of the 220 kV line;
(iv) The routing follows that proposed from Auas south to the Kalkrand area to avoid the vulture-breeding areas north of Kalkrand.
(v) Near Kalkrand (BP010) 14 km of the line requires bird diverters as it traverses a high-risk vulture area.

(vi) The two lines (proposed 400kV and existing 220 kV) cannot deviate from each other for more than 2 km in any 100 km length as this will negate the staggered pylon mitigation.

Rationale

The reason for the change in recommendations from the original mitigations and recommendations in BBU (2017) are as follows:

(i) there are technical difficulties in routing the proposed line west of the B1,

(ii) from an avian perspective the existing 220 kV lines runs, largely un-mitigated, through habitat that holds high densities of the most collision-prone threatened group – the bustards. As such, by running another line adjacent to it, with staggered pylons, this and the new line can provide mitigation for each other.

(iii) NamPower agreed to using shorter towers for the proposed lines (i.e. of similar height to the existing 220 kV line), this will increase the likelihood of bustards seeing the 400 kV line as it will now be on the same level as the existing 220 kV line.

(iv) The new routing for the 400 kV line (following the 220 kV line) may be a better option than leaving the 220 line unmitigated and running the proposed line next to the existing 400 kV west of the B1 (where bustard densities are expected to be lower).

The new proposal (pink line in Figure 1) is longer than the original proposed routing (black Line in Figure 1). However, in running parallel to an existing 220 kV it allows both to be mitigated through the highest density habitat for the bustards, (Karas Dwarf Shrubland, purple polygon in Figure 1). This gives it an advantage over running parallel to the 400 kV line which largely avoids the highest density bustard areas. As such the new routing (pink line in Figure 1) can satisfy all mitigations to reduce bustard deaths as well as other concerns further north.

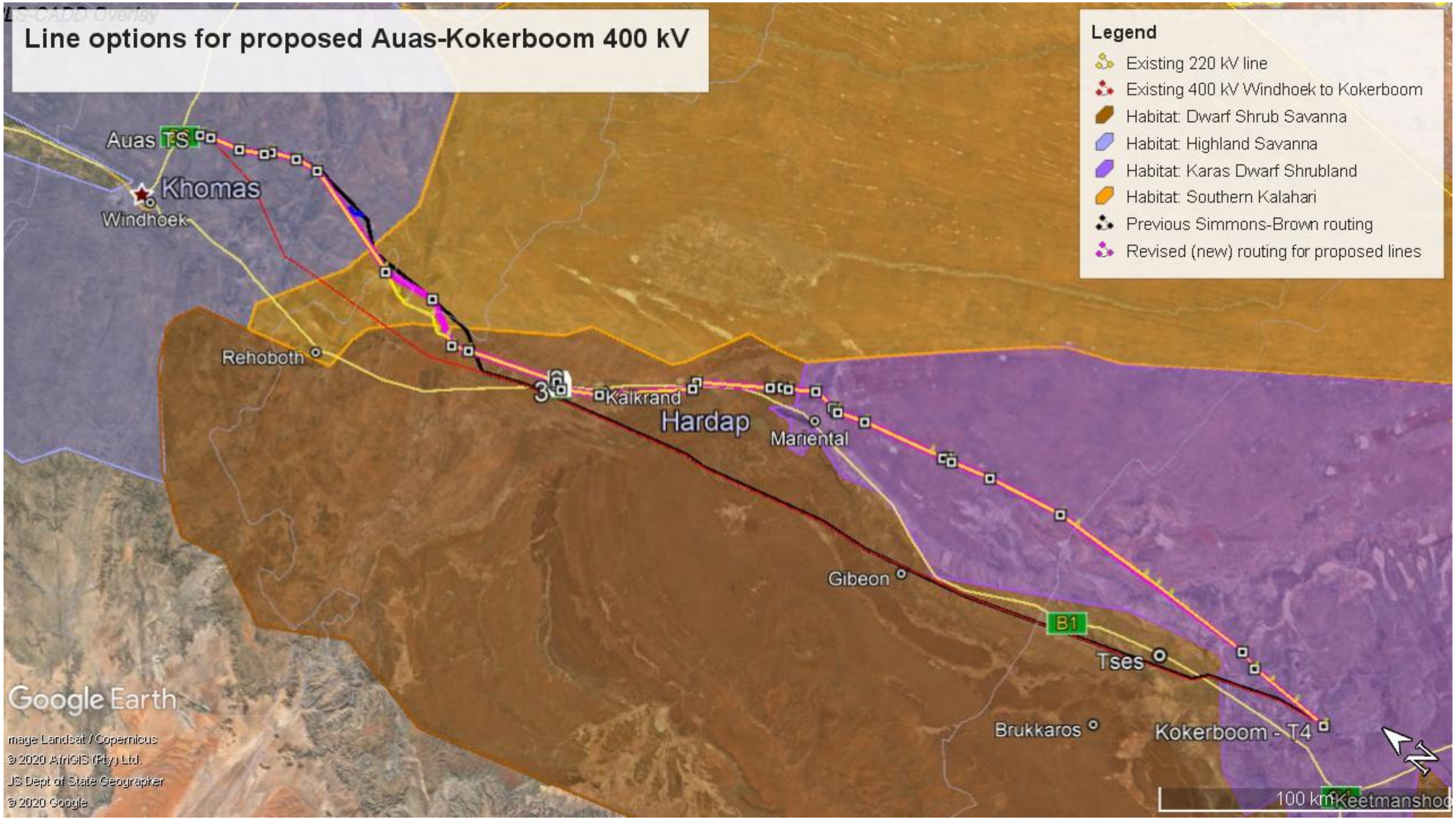

Figure 1: The routings of all proposed options for the Auas-Kokerboom 400 kV line. The original routing (= black line) proposed by avian specialists (Simmons-Brown) and the present revised routing (= pink line) that runs adjacent to an existing 220 kV line (= yellow line). North is to the top left.

Vultures A short section of the line intersects a previously identified high-risk vulture site (south of point BP014: Figure 2). White-backed Vultures *Gyps africanus* use this area and it has been agreed with NamPower that bird diverters must be added to this 14 km section on the earth wire of the proposed 400 kV line to reduce further any possible impacts by these large and relatively unmaneuverable species. It was also agreed that the 14 km section would have 7km of diverters (ideally spirals on the earth wires of the proposed 400 kV) and 7km without. We suggest 2km section with diverters, alternating with 2km sections with no diverters to test their efficacy in reducing vultures collisions These would then be searched for collision victims as set out in the EMPr (below).

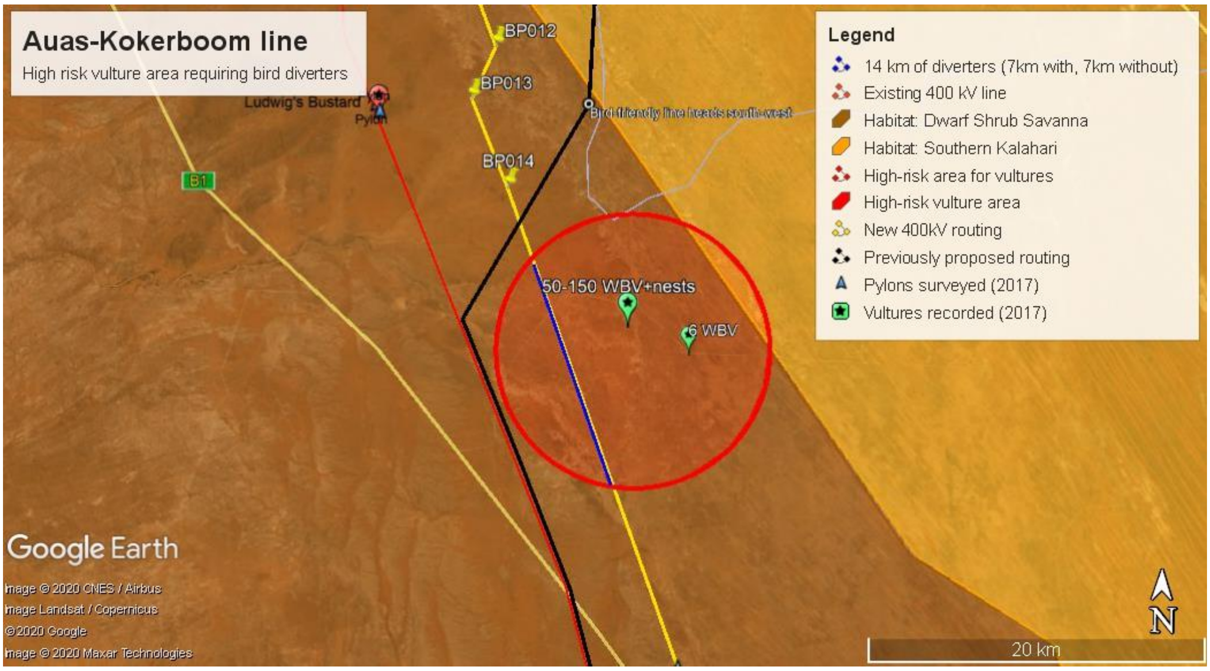

Figure 2: A 14-km section (= blue line) of the new routing that passes close to known vulture areas. This section south of the NamPower coordinate of BP014 requires extra mitigation in the form of bird diverters. The ideal configuration would be 2km of spirals, followed by 2km without spirals repeated down the line. This whole section will need to be included in the surveys described in the EMP below.

2. ENVIRONMENTAL MANAGEMENT PLAN

The aim of this EMP is to understand:

- the effect of the new line on the avifauna in the area (both positive and negative);
- the effectiveness of the mitigations proposed, particularly the "staggered pylons" idea.

This can be achieved by survey work along sample areas of both the existing 220 kV line and the existing 400 kV line (as a control for the staggered pylons once in place), in all 4 main habitats before and after construction. This should be undertaken as follows:

- by a competent ornithologist familiar with power line work and able to identify species found dead under power lines from their remains (feathers and wing bones);
- known-distance surveys to be undertaken 3-months and 9-months before construction of the two lines. The first should be undertaken in the dry season (to clear the line of any carcasses) with a follow-up survey just after the rain season (Feb – March);
- This should include (i) the existing 220 kV line in all four habitat types and (ii) the existing 400 KV line south to Kokerboom and include samples from all three habitats;
- surveys to be undertaken again 3-months and 9-months *after construction* of the line, one survey must include the wet season; this must be repeated in a second year post-construction;
- a minimum of 20% of the new line (20% of 461 km is 92 km) within all 4 habitats identified must be surveyed for bird carcasses along the same sections as surveyed along the adjacent 220 line in the previous surveys; this must be compared with 20% of the sampled 400 kV line west of the B1 in similar habitats;
- the number of carcasses found per km (with each carcass photographed next to a GPS with the point logged) should be compared with fatalities found along similar lengths of the other 400 kV line in similar habitats,;
- Specific surveys must be undertaken of the 14 km of proposed line that occurs within the high risk vulture area near Kalkrand (Figure 2). This must be included in pre-construction surveys and post-construction surveys to assess the efficacy of the bird spirals along the earth wires.
- ideally, the same sample areas as those detailed in the BBU (2017) report should be used for direct comparisons.

These data should be compared and analysed after the 3- and 9-month assessment periods, to determine the rate of fatalities occurring per km, the species involved, and if the mitigation measures (either staggered pylons or the use of bird diverters) are effective. These surveys should be undertaken with the support of NamPower officials to share and discuss all results and any challenges arising from the surveys. NamPower officials will also be required to access all the lines.

Should high risk areas be identified (numbers of bustards killed by the line exceeding 1 per km of line, or for vultures numbers killed exceed 1 per 7km of line) then additional mitigation measures must be enacted within 3 months of the survey results.

The results should be published in local journals (e.g. *Namibian Journal of the Environment*) to publicise the results. They should also be added to the NamPower- bird data base curated by Dr Ann Scott.

The survey work will be supported jointly by the Namibian Chamber of Commerce (Dr Chris Brown pers comm) and NamPower (Martin van der Merwe pers. comm).

Dr Rob Simmons 26 August 2020

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www.Birds-and-bats-unlimited.com

Review of the avifauna impact assessment study for the proposed new Kokerboom-Auas 400 kV transmission line, Namibia

Name of the project	**Proposed new Kokerboom-Auas 400 kV transmission line**
Location of the project	Keetmanshoop Substation, southern Namibia to Auas Substation, Central Namibia
Title of the report	EIA for the proposed Kokerboom-Auas 400 kV transmission line - Avifaunal Assessment Report
Name of company/ consultant that compiled the report	Dr Rob Simmons 8 Sunhill Estate, Capri, South Africa 7975 Email: rob.simmons@uct.ac.za Tel: + 27 82 780 0133
Name of the company for which the report was compiled	Lithon Project Consultants (Pty) Ltd
Date that the report was completed	August 2018
Name of the company requesting the review	Enviro Dynamics Environmental Management Consultants Norman & Stephanie van Zyl PO Box 4029, Windhoek, Namibia Email norman@envirod.com; stephnie@envirod.com
Date that the review was requested	12 September 2019
Purpose of the review	A review the avifauna report (Simmons 2018) was requested to assess the two alternative routes (i.e. along the existing 220 kV and 400 kV lines), according to the following criteria: 1. Will it make a material difference to the impact on birds if the existing 220 kV route is used instead of the existing 400 kV route? 2. Is the 400 kV route at the Hardap Dam significantly less of a risk to birds than the 220 kV route in the same area? 3. Is there a significant difference in cumulative impact on birds between the two routes at the Hardap Dam? 4. Is the 400 kV route between Mariental and Keetmanshoop (running along the Fish River) significantly different in risk for birds than the 220 kV route?
Name of reviewer	African Conservation Services cc Dr Ann Scott & Mike Scott PO Box 2604, Swakopmund, Namibia Email ecoserve@iway.na
Date of review	25 September 2019 (Draft 1) 27 September 2019 (Draft 2)
Summary of findings of the review	• High numbers of Ludwig's Bustard and Kori Bustard collisions have been recorded in the open (Karas Dwarf) shrubland/220 kV route; however, the survey effort has been lower on the

	400 kV line, and current results indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas • Apart from the revised alignment of the new power line route, the Avifaunal Assessment Report has also recommended a staggered pylon design as one of the primary mitigations. The review has found that there would be a greater natural staggering effect in a 220 kV/400 kV combination, which in the 400 kV/400 kV combination would mostly need to be achieved by design as span lengths are the same; however, the collision risk for either combination could also potentially be increased by staggering, as cables (conductors, optical fibre ground wires and earth wires) would be at different heights on the two structures, especially at midspan, thereby increasing the potential density of the barrier presented to all flying birds • A high concentration of waterbirds, including at least 10 Red Data species, is associated with the Hardap Nature Reserve/Dam Important Bird Area, with a high risk of waterbird collisions • The 220 kV route is closer to the dam and irrigation schemes (and other potential attractants) than the 400 kV route, and more likely to lie on potential bird flightpaths • The cumulative impact on birds between the two routes at Hardap Dam is therefore likely to be relatively lower in the case of the 400 kV line, as it is further away from the dam • The Fish River and its associated aquatic habitats on the 400 kV route should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds.

Contents

Executive summary

Enviro Dynamics Environmental Management Consultants has been appointed to evaluate the current status on the EIA process for the new 400 kV transmission line from Auas Substation at Windhoek in Central Namibia to Kokerboom Substation at Keetmanshoop in Southern Namibia, as was conducted by Lithon Project Consultants.

The initial proposed route, after screening, was aligned with the existing 220 kV line east of the B1 road. The subsequent Avifaunal Assessment Report (Simmons 2018) recommends that the route should follow the existing 400 kV line route, rather than the 220 kV route.

The client, NamPower, has requested an objective review of the opinion in the above Avifaunal Assessment Report in a very specific way with regard to the above two alternative routes, according to the following criteria/Terms of Reference:

- Will it make a material difference to the impact on birds if the existing 220 kV route is used instead of the existing 400 kV route?
- Is the 400 kV route at the Hardap Dam significantly less of a risk to birds than the 220 kV route in the same area?
- Is there a significant difference in cumulative impact on birds between the two routes at the Hardap Dam?
- Is the 400 kV route between Mariental and Keetmanshoop (running along the Fish River) significantly different in risk for birds than the 220 kV route?

After due consideration of the Avifaunal Assessment Report and other available information, the findings of the review are as follows:

- High numbers of Ludwig's Bustard and Kori Bustard collisions have been recorded in the open (Karas Dwarf) shrubland/220 kV route; however, the survey effort has been lower on the 400 kV line, and current results indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas
- Apart from the revised alignment of the new power line route, the Avifaunal Assessment Report has also recommended a staggered pylon design as one of the primary mitigations. The review has found that there would be a greater natural staggering effect in a 220 kV/400 kV combination, which in the 400 kV/400 kV combination would mostly need to be achieved by design as span lengths are the same; however, the collision risk for either combination could also potentially be increased by staggering, as cables (conductors, optical fibre ground wires and earth wires) would be at different heights on the two structures, especially at midspan, thereby increasing the potential density of the barrier presented to all flying birds
- A high concentration of waterbirds, including at least 19 Red Data species, is associated with the Hardap Nature Reserve/Dam Important Bird Area, with a high risk of waterbird collisions
- The 220 kV route is closer to the dam and irrigation schemes (and other potential attractants) than the 400 kV route, and more likely to lie on potential bird flightpaths
- The cumulative impact on birds between the two routes at Hardap Dam is therefore likely to be relatively lower in the case of the 400 kV line, as it is further away from the dam
- The Fish River and its associated aquatic habitats on the 400 kV route should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds.

Consultant's declaration of independence

Dr Ann Scott and Mike Scott of African Conservation Services cc are independent consultants subcontracted by Enviro Dynamics Environmental Management Consultants. We are registered Ordinary Member Practitioners with the Environmental Assessment Practitioners Association of Namibia (EAPAN) and uphold its Code of Conduct. We have no business, financial, personal or other interest in the activity, application or appeal in respect of which we were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise our objectivity as a specialist in performing such work.

Dr HA Scott RM Scott

27 September 2019

1. Background

Reason the review was requested, and criteria/Terms of Reference

Enviro Dynamics Environmental Management Consultants has been appointed to evaluate the current status on the EIA process for the new 400 kV transmission line from Auas Substation at Windhoek in Central Namibia to Kokerboom Substation at Keetmanshoop in Southern Namibia, as was conducted by Lithon Project Consultants.

The initial proposed route, after screening, was aligned with the existing 220 kV line east of the B1 road. The subsequent Avifaunal Assessment Report (Simmons 2018) recommends that the route should follow the existing 400 kV line route, rather than the 220 kV route.

The client, NamPower, has requested an objective review of the opinion in the above Avifaunal Assessment Report in a very specific way with regard to the above two alternative routes, according to the following criteria/Terms of Reference:

1. Will it make a material difference to the impact on birds if the existing 220 kV route is used instead of the existing 400 kV route?
2. Is the 400 kV route at the Hardap Dam significantly less of a risk to birds than the 220 kV route in the same area?
3. Is there a significant difference in cumulative impact on birds between the two routes at the Hardap Dam?
4. Is the 400 kV route between Mariental and Keetmanshoop (running along the Fish River) significantly different in risk for birds than the 220 kV route?

Scope of the review

The review is confined to addressing the above criteria/Terms of Reference, based on the findings of the Avifaunal Assessment Report (Simmons 2018) in terms of the alignment/routing of the new power line. An earlier draft of the above report (Simmons & Martins 2017) was also consulted for more detailed information. The review does not provide comment on the further mitigation recommendations in the avifaunal report, unless relevant to the review.

The impacts are discussed according to the above given criteria with regard to the line routes, as indicated in Figure 1; according to this information, the sections north of Duineveld and running through the Southern Kalahari and the Highland Shrubland are identical for both lines (i.e. from 23° 37' 23.34"S 17° 26' 34.30"E northwards); the focus is therefore on the sections of line south of this point, and mainly on power line-sensitive Red Data (and Namibian near-endemic) species occurring in this area.

2. Main findings of the Avifaunal Assessment Report for the proposed Kokerboom – Auas 400 kV transmission line EIA

Scoping and assessment reports for the EIA

The Avifaunal Scoping Report for the EIA for the proposed Kokerboom to Auas 400 kV transmission line was completed in 2015 (Brown 2015). Three alternative power line corridors were assessed during the Scoping Assessment. Although involved in the scoping of the above power line corridor alternatives, the technical specialists assessed only the "favoured" alternative corridor in detail (Figure 1). The (then) preferred corridor alignment avoided identified sensitive environmental features and thus potential negative impacts, most notably on sensitive perennial pans and an avifauna hotspot, as well as social infrastructure; this corridor is also as close as practical to the existing line for part of its route.

The Avifaunal Assessment Report for input into the Impact Assessment Report for the Environmental Impact Assessment (EIA) of the above line was completed in 2018 (Simmons 2018 and an earlier draft, Simmons & Martins 2017). The assessment report is aligned with the above scoping report, and is based partly on national long-term bird data collection projects sourced from the Namibia's Avifaunal Database (NAD), and mainly on a 10-day on-site survey in September 2017, sampling 157 km of the proposed route and existing power lines (Figure 1).

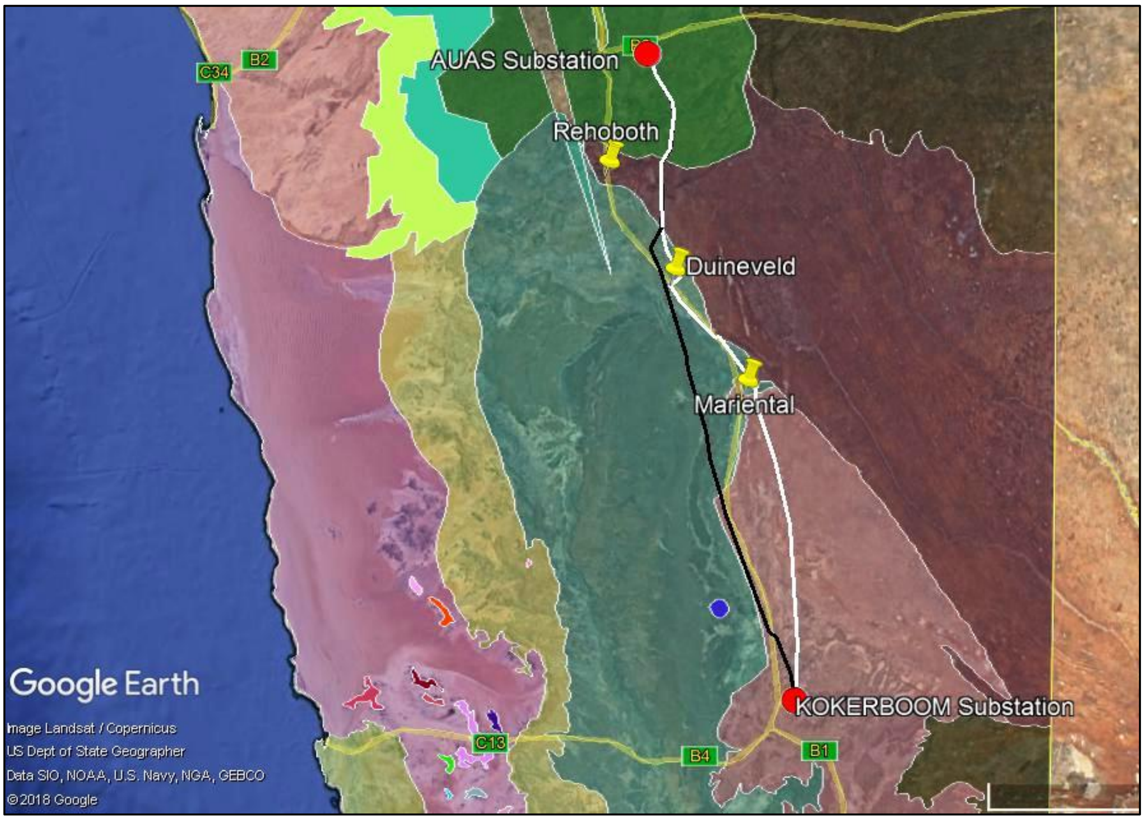

Figure 1. The initially proposed ("favoured") corridor for the new 400 kV power line (white line), based largely on the existing 220 kV line to the east, and the subsequently proposed alternative route (black line), based largely on the existing 400 kV line to the west; the two routes follow the same route (white line) from Duineveld northwards to Auas SS; vegetation types through which the two routes run are also indicated (light purple = Karas Dwarf Shrubland; grey-green = Dwarf Shrub Savanna; dark purple = Southern Kalahari; dark green = Highland Shrubland) (EIS 2019; based on a Google Earth image).

Technical details of the proposed power line

NamPower proposes to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (SS; near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km (Simmons 2018). The two substations are currently connected via two existing transmission lines, a 220 kV line to the east and a 400 kV line to the west (Figure 1).

The pylon design of the new line will be of the Open-V or the Self-Supporting design, approximately 45 m high, and the distance between pylons approximately 500 m. The pylons will be placed on a 10 m by 10 m concrete base. The proposed line will have a final servitude of 80 m width, with 12 m of that being cleared for an access track.

Objectives of the avifauna study

The objectives of the Avifaunal Assessment Report are to present a description of the avifauna in the local area (i.e. receiving environment) and region through which the proposed power line corridor traverses, identify potential impacts on the avifauna during the construction and operational phases of the proposed project, identify potential impacts of the avifauna on the proposed infrastructure, assess impacts, and propose suitable enhancement and mitigation measures. Emphasis was placed on the optimisation of route as well as cumulative impacts of two (existing) power lines within the study area.

Data sources

The study includes a desktop study, using Namibia's "Powerlines and birds assessment tool" on the Environmental Information Service (www.the-eis.com), established by the NamPower/Namibia Nature Foundation (NNF) Partnership and covering the period 2009-2017 (EIS 2017); Namibia's Avifaunal Database (NAD); and published papers and reports as well as the extensive experience of the consultant on the birds of Namibia. The study was supplemented by a review of extensive unpublished mortality data obtained after a full year's systematic monitoring of the power lines in open habitats south of Keetmanshoop in 2012-2013 (J Pallett *in litt*; Simmons & Martins 2017).

The above results were verified by means of a 10-day on-site field survey of 157 km of line (11-20 September 2017).

Vegetation / habitat types and sensitivities for the proposed transmission line route

The proposed line route runs north from the Kokerboom Substation near Keetmanshoop to the Auas Substation near the Hosea Kutako International Airport east of Windhoek (Simmons 2018). The report identified four different vegetation types of two biomes that would be traversed (Figure 1; also see Table 1 for summary), over a rainfall gradient ranging from just under 200 mm in the south to about 400 mm in the north.

Nama Karoo biome

In the south the transmission line passes through **Karas Dwarf Shrubland** for about 205 km (Kokerboom to near Mariental) and across the eastern edge of the **Dwarf Shrub Savanna** for about 142 km (near Mariental to Duineveld). The topography comprises mainly gravel and rocky undulating plains with low shrubs and grassland.

Acacia Tree-and-shrub Savanna biome

The transmission line then runs along the western edge of the **Southern Kalahari** for about 43 km (Duineveld to near Rehoboth) and into the **Highland Shrubland** for about 77 km (Rehoboth to Auas). The topography of the Southern Kalahari comprises wind-blown red Kalahari sand forming linear partly vegetated dunes with grassy inter-dune "valleys". The land rises in the Highland Savanna to about 1,800 m and consists of an undulating highland plateau with mountain ranges rising to over 2,500 m.

In the Mariental area the proposed transmission line route passes within ~10 km of the **Hardap Dam**, the only large artificial impoundment with a significant fish-eating bird population along the proposed route. Wetland birds often perch on nearby power line support structures, making them potentially vulnerable to electrocution, but also causing flash-overs which impact of power supply.

The above two biomes support Red Data species which require special conservation attention.

- Both biomes provide important habitat for many species endemic to the south-west arid zoo-geographic zone of southern Africa, with 14 of these species having 40% or more of their global populations within Namibia. The Highland Shrubland is particularly important for species near-endemic to Namibia, for which Namibia has primary global responsibility.
- The Nama Karoo and Acacia Tree-and-shrub Savanna biomes provide the core range of a number of large cursorial birds such as bustards and korhaans, as well as vultures which are at high risk from power line collision. The *Endangered* Ludwig's Bustard and *Near Threatened* Kori Bustard have recently been listed at threatened in Namibia because of the high incidents of mortality on power lines (Simmons et al. 2015).
- Other species such as the Greater Flamingo, Secretarybird and other large birds of prey (eagles) could also potentially be impacted.

Additional details of five areas of High-Risk identified during the above surveys (Simmons & Martins 2017) include:

- Two (Red Data) Verreaux's Eagle nest sites in the first major Schaap River valley on the farm Volmoed, 13-km west of Dordabis;
- Up to 100 (Red Data) White-backed Vultures reported (also nests; vulture restaurant on farm) and Black-chested Snake Eagles recorded in the Klipvlei and Wilderness farms, respectively 70-km and 135-km south of Auas substation;
- Bustard mortalities on existing 400 and 220 kV lines occurred throughout, but were highest in the open (Karas Dwarf) shrubland in the south – particularly in open gravel/grassy plains areas.

Power line mortality data

According to the NamPower/Namibia Nature Foundation Strategic Partnership database (October 2017; EIS 2017), the top five bird collision species in the Namibian landscape are flamingos ((39%), bustards (176%), korhaans (4%), vultures (3%) and eagles (3%) (Simmons & Martins 2017). These species together comprise 487 (77%) of the total of 631 individuals involved in power line incidents as recorded over eight years. Worryingly, four of the top five are also Red Data species. Most of the flamingos were recorded at the central coast (A Scott pers comm.), while bustards are recorded throughout, but in large numbers in the south (J Pallett pers comm.).

The field surveys conducted in September 2017 yielded the following results (Simmons 2018):

- 13 bustard carcasses under the transmission lines, over a distance of 157 km.
- These carcasses were evenly distributed with respect to the different sized transmission lines - 0.08 and 0.09 fatalities per km were recorded, respectively, under the 400 kV and 220 kV lines.
- Open grassy habitat was five times more likely to sustain bustard mortalities than Closed Thornveld Thicket. This concurs with a general low avian diversity in bush-thicket elsewhere in Namibia (Seymour et al. 2015 in Simmons 2018).

The (un-adjusted) data systematic monitoring data for 325 power line fatalities recorded during 2012-2013 in the Keetmanshoop area (J Pallett *in litt*.) indicated a total estimate of 0.66 fatalities/km/year on the 400 kV line, and of 0.45 fatalities/km/year on the 220 kV line (32% less than the 400 kV line). Eight of the 13 species fatalities recorded were Red Data species; and 246 (76%) of the total fatalities recorded were bustards, predominantly Ludwig's Bustards (133 or 54% of 246).

At the above fatality rates (0.66 birds/km/yr), the report forecasts that the new 462 km 400 kV transmission line could result in a minimum of (462 x 0.66 birds/km/year =) 305 bird mortalities per year, without mitigation; of these, 91% (278 bustards and vultures; 231 bustards) are expected to be red data birds (Simmons 2018).

Main impacts identified in the Avifaunal Assessment Report

The main impacts of power lines on birds during the operational phase are identified in the report as follows (see Table 1 [Simmons 2018, Table 4.2, reproduced below]):

Table 1. Operational Phase Impacts Without and With Mitigation (Simmons 2018, Table 4-2).

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Avian impacts										
Impact Description: Birds are negatively impacted by power lines and associated infrastructure in two main ways: direct impact on the earth wires or conductors (rarely on the towers) and by electrocution. They may cause flash-overs when streamers from defecation span an air-gap causing a short circuit and short-term power outage down the line. One positive impact for the birds is that for some species, especially tree-nesting raptors, pylons provide perch and nesting sites where none existed previously										
Mitigation	Negative	Regional	Long-term	High	low	High	Reduced population size of bustards and other red data	High	High	High
Mitigation Description: Avoid routing the new line through all areas identified as high risk in the avian assessment. Two of the main areas are (i) the vulture feeding and breeding areas in Kalahari Sand savannah north of Kalkrand and (ii) the high bustard mortality areas in the open grassy and gravel plains of the dwarf shrub savanna south of Kalkrand. The high avian mortality rates in the Dwarf Shrub Savanna are best mitigated for the collision-prone bustards by aligning the proposed line adjacent to the existing 400 kV line from Kalkrand south and staggering the pylons. This is predicted to reduce the estimate high mortality of 300 bustards per year by at least 50%.										
Mitigation	Negative	Regional	Long-term	Medium	low	Medium	Reduced population size of bustards and other red data birds	High	Medium	Medium
Cumulative Impact: Thousands of kilometres of high voltage power lines criss-cross Namibia and South Africa and red data birds such as bustards, cranes, and vultures are killed and less-often electrocuted on these lines. Including those killed on the smaller reticulation lines 46 000 bustards are estimated to be										

killed annually in South Africa (Shaw et al. 2015a) and similar figures are likely for Namibia. This is causing population declines. Thus, there are wide-spread and far-reaching cumulative effects for the collision-prone red data species in southern Africa and the staggered pylon mitigation may be the most effective means of reducing this exceptionally high mortality rate.

Recommended mitigation measures in terms of the power line route/alignment

The Avifaunal Assessment Report (Simmons 2018) recommends that, as discussed in the Avifauna Scoping Report (Brown 2015), the preferred alternative from an avifaunal perspective would be to align the proposed 400 kV transmission line as close as possible to the existing 400 kV line (Figure 2). This route:

- avoids the Red Data Verreaux's Eagles, and most of the Red Data vultures in the areas south of Dordabis through the Klipvlei farm area; and
- could reduce the high mortality experienced by bustards across their range by increasing the visibility of the power lines along its length especially in the south (i.e. by increasing the visibility of the midspan).

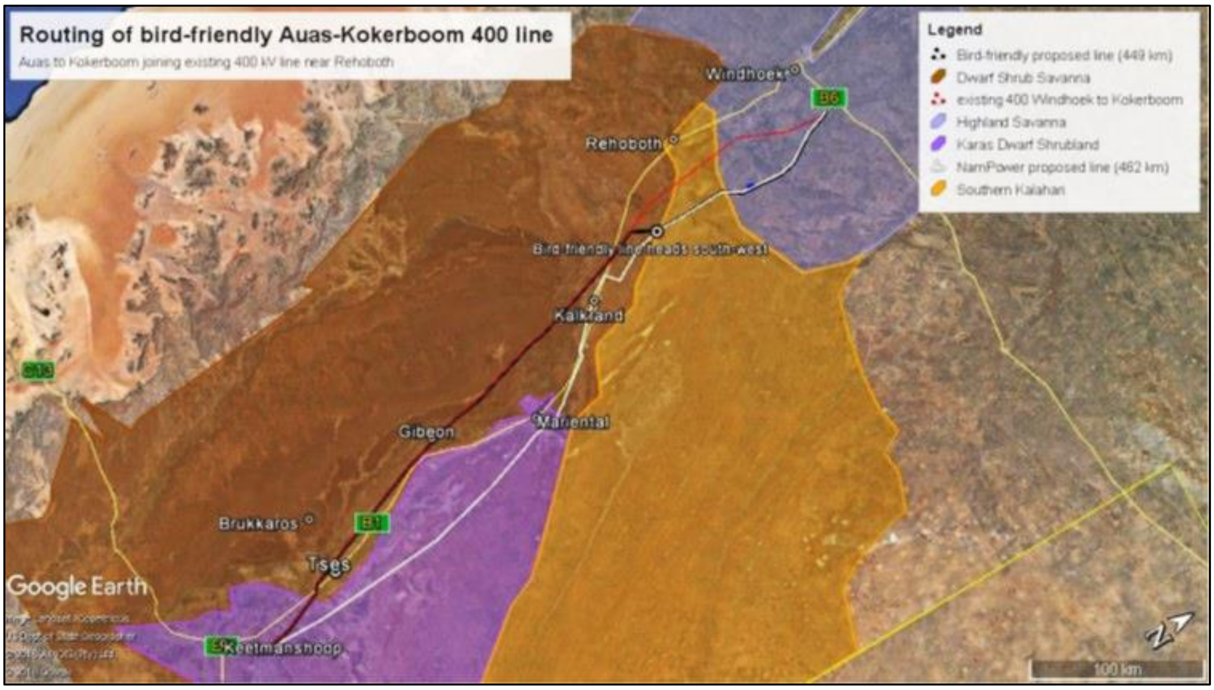

Figure 2. (Simmons 2018, Figure 3-1): Locality Plan indicating the proposed bird-friendly alignment of the Kokerboom – Auas Transmission Line. The line follows the NamPower routing in the northern sections and then joins and parallels the existing 400 kV line near Kalkrand south to Kokerboom.

Conclusions of the Avifaunal Assessment Report (Simmons 2018)

Power lines across the Karoo and semi-arid Tree-and-shrub Savanna biomes, in both Namibia and South Africa, have been shown to have a significant impact on some bird species, mainly as a result of birds flying into the lines. Ludwig's Bustard, Kori Bustard and White-backed Vulture are all listed as Threatened Red Data species. In the case of the bustards, the main cause of mortality appears to be power line collisions, resulting in significant population declines. For a number of other large Red Data bird species such as flamingos, other vultures and eagles, power line collision is an important contributing factor to the level of threat that they face.

In terms of the routing of the new power line, the Avifaunal Assessment Report concluded that:

- The transmission line proposed centre-line has been revised to avoid impacts on known existing avian "hotspots", as far as possible. NamPower identified a suitable routing option for the transmission line with input from the environmental consultants and relevant specialists. The realignment has served to avoid and reduce potential negative impacts of the proposed Project on sensitive avifaunal areas, such as the vultures breeding north of Kalkrand and the bustards migrating into and out of the Dwarf Shrub Savanna in southern Namibia. As such the re-alignment of the proposed power line corridor has already served to avoid and reduce potential negative impacts of the proposed Project on avifauna.
- By realigning the new lines adjacent to the existing 400 kV line and **staggering the pylons,** the high bustard fatality rate is expected to be reduced to acceptable levels. Because most bird strikes take place with conductors and earth wires between the towers – usually mid-span, the ideal configuration would be to place the towers of the proposed line about mid-way between the towers of the existing line. Thus, the towers of each line would help mitigate bird strike on the respective adjacent line. This new mitigation measure arises because extensive research shows that bustards (the main collision species) hit the towers themselves by only about 10% of the time, and thus seem to avoid them. Thus, by aligning the tower of one line with the mid-span of the adjacent line, bustard fatalities could be reduced by >50%.This may make a significant contribution to reducing bird strikes on both lines.

For this (staggered pylon) mitigation to be fully effective, and at the same time take cognizance of the engineering limitations conveyed in discussion with NamPower staff, the report proposes that from the Auas substation it follows the NamPower routing via Dordabis and south towards Kalkrand. Approximately 43 km north of Kalkrand, vulture breeding areas are encountered and the report suggests that the proposed line deviates south west from the proposed route at S23°37'23.16" E 17°26'32.99" and joins the existing 400 kV line at S23°44'36.60" E 17°22'10.26". From here the bird-friendly line runs for ~312 km adjacent to the existing 400 kV line, with pylons staggered as described above to reduce bustard mortalities. This routing is also 14-16 km shorter than the NamPower-proposed line to the east. The proposed bird-friendly line also occurs further from the Hardap Dam (a major source of waterbirds that may impact the line), i.e. ~20 km instead of ~10 km.

In summary:

The proposed mitigation measures for implementation during the operational phase to reduce potential negative impacts focus on the route/alignment of the new power line are, namely to:

- Avoid the high risk areas identified in the avian assessment, particularly north of Kalkrand where vultures feed and breed in the Kalahari biome (starting at S23°44'47" E 17°28' 04")
- Follow the routing of the existing 400 kV line for as far as possible south of Rehoboth
- Stagger the pylons of the two adjacent 400 kV lines such that the tower of one is aligned approximately with the mid-span of the adjacent line
- Where high fatalities continue to occur bird diverters (spirals or flappers) should be attached to the earth wire

These mitigation measures are to be incorporated in the project Environmental Management Plans (EMPs) for the construction and operational phases, and applied as necessary.

3. Discussion on the main findings of the Avifaunal Assessment Report for the proposed Kokerboom – Auas 400 kV transmission line EIA, in terms of addressing the criteria/Terms of Reference for the review

Introduction

As mentioned above, the review is confined to addressing the supplied criteria/Terms of Reference in an objective way, based on the findings of the Avifaunal Assessment Report (Simmons 2018) in terms of the alignment/routing of the new power line. It does not provide comment on the further mitigation recommendations in the report, unless relevant to the review.

The review supports the principle, according to generally accepted best practice and as stated in the above Avifaunal Assessment Report, that reducing the extent of collision is usually best approached by aligning the route of the power line to avoid sensitive features including the proximity of wetlands and bird flight paths, as well as habitat that supports high populations of vulnerable species.

The discussion deals with power line/tower structures; vegetation/habitat types for the proposed transmission line route; sensitive habitats/species; power line mortalities; and, finally, a comparative assessment of impacts according to the criteria supplied.

A comparative summary of habitat types, details of bird species of concern and environmental sensitivities/high risk areas for the proposed new 400 kV Kokerboom-Auas power line is provided in Appendix 1; details of proposed power line structures (including photographs) in Appendix 2; distribution maps for focal bird species in Appendix 3; and scientific names of bird species mentioned in the review in Appendix 4.

The discussion is based on the two alternative power line routes as indicated in Figure 1, according to which the sections north of Duineveld and running through the Southern Kalahari and the Highland Shrubland to the Auas Substation are identical for both lines (i.e. from 23° 37' 23.34" S / 17° 26' 34.30" E northwards). The discussion therefore focuses on the section of lines south of this point, and mainly on power line-sensitive Red Data (and Namibian near-endemic) species occurring in this area.

Power line / tower structures

Details of the proposed power line/tower structures below were confirmed by NamPower (K Nghitevelekwa and M van der Merwe pers. comm. Sept 2019).

Three types of towers are envisaged (also see Appendix 2 for details and photographs):

- The suspension tower is very basic but has a larger footprint: less steelwork, only two major foundations required plus minor foundations for the cross ropes.
- The self-supporting towers and the strain towers on the other hand are more complex and have a lesser footprint: more steelwork and four major foundations.

The line would be 400 kV single circuit, consisting of three phases of four each tern conductor, with 1 x Optical Fibre Ground Wire and 1 Earth Wire.

The Cross-Rope Suspension Tower can accommodate only straight sections, or angles up to 2 degrees.

Perching and electrocution risk

The Cross-Rope Suspension Tower structures are not really attractive for larger birds to perch on.

The strain tower is a more complex structure, and is suitable for bend points. These towers may be attractive for birds to sit on top, and it is sometimes found that smaller birds make nests in some structures.

Electrocutions are considered highly unlikely on 400 kV lines – the nature of the structure and the way the conductor is supported results in approximately 3.0 meters of clearance between different phase conductors and the structure. Bird deaths are more often the result of collisions. The risk of short circuits due to streamers is higher on the lower voltage lines, where this clearance is much less.

Comments on staggered alignment of towers of adjacent power lines

A comparison of the components of the proposed 400 kV line and the existing 400 kV and existing 220 kV lines is provided in Table 2 (information confirmed by M van der Merwe, NamPower Sept 2019).

Table 2. Comparative components of the three power line structures under discussion.

Line	Structure (straight sections)	Tower height (m)	Span length (m)
Proposed 400 kV	Guyed-V / cross rope suspension tower	Average 38m, up to 44m	Average 450m
Existing 400 kV	Guyed-V / cross rope suspension tower (Type 525 / 518)	Average 38m, up to 44m	Average 450m
Existing 220 kV	Self-Supporting Lattice	35m	Average 420m

The average height of 400 kV towers would be 38-44 m and the span length 450 m, whereas the average height of the 220 kV tower is 35 m and span length 420 m.

The minimum distance between a 400 kV line and a 220 kV line, or between two 400 kV lines, would be the same, i.e. 45 m, measured between the centrelines. The servitude width for a 400 kV and 220 kV line in parallel would be 110 m, whereas the servitude width for 2 x 400 kV lines would be 125 m.

There will always be a natural staggering of the two lines in parallel (P van Niekerk, NamPower pers. comm. May 2018). They are far apart so the angle at which the birds approach the line will always give it a natural stagger. The new line will also have a different span length between towers than the existing line (here referring to the proposed 220 kV line route), as this is a different tower design when compared with the existing line. Technical constraints apply with regard to the extent that staggering can be incorporated into the design, as it is also reliant on the number of spans between strain towers and terrain.

Vegetation / habitat types for the proposed transmission line route

The proposed line route runs through four different vegetation types of two biomes, over a rainfall gradient ranging from just under 200 mm in the south to about 400 mm in the north (Figure 1).

In the Nama Karoo biome in the south, the transmission line passes through **Karas Dwarf Shrubland** for about 205 km (Kokerboom to near Mariental) and across the eastern edge of the **Dwarf Shrub Savanna** for about 142 km (near Mariental to Duineveld). The topography comprises mainly gravel and rocky undulating plains with low shrubs and grassland. The dominant plant structure in Karas Dwarf Shrubland is grasslands and low shrubs, and therefore somewhat more grassy than the low shrub habitats of Dwarf Shrub Savanna (Mendelsohn et al. 2002). Grassier habitats are attractive to bustards, especially after recent rains.

In the Acacia Tree-and-shrub Savanna biome in the northern parts of the route, the transmission line then runs along the western edge of the **Southern Kalahari** for about 43 km (Duineveld to near Rehoboth) and into the **Highland Shrubland** for about 77 km (Rehoboth to Auas). The dominant plant structure in Southern Kalahari is open Acacia woodlands, whereas shrubs and low trees are characteristic of Highland Savanna (Mendelsohn et al. 2002).

Sensitive habitats / bird species

Five areas of High-Risk were identified in the Avifaunal Assessment Report (Simmons & Martins 2017; Simmons 2018; also see Appendix 1). These include:

- Two (Red Data) Verreaux's Eagle nest sites in the first major Schaap River valley on the farm Volmoed, 13-km west of Dordabis;
- Up to 100 (Red Data) White-backed Vultures reported (also nests; and vulture restaurant on farm) and Black-chested Snake Eagles (collision-sensitive) recorded in the Klipvlei and Wilderness farms, respectively 70-km and 135-km south of Auas Substation;
- Bustard mortalities on existing 400 kV and 220 kV lines occurred throughout, but were highest in the open (Karas Dwarf) shrubland in the south – particularly in open gravel/grassy plains areas.
- In the Mariental area the proposed transmission line route passes within ~10 km of the Hardap Dam, the only large artificial impoundment, with a potential for electrocutions of waterbirds perching on nearby power line support structures, and also for causing flash-overs which impact of power supply.

As indicated in Appendix 1, the latter group includes a large number of waterbird species associated with the Hardap Nature Reserve/Dam, an Important Bird Area (IBA; Simmons et al. 1998; Figure 3) holding >0.5% of the biogeographic population of a congregatory waterbird species, namely Great White Pelican (*Vulnerable*) and including its main breeding site in Namibia (with up to 250 nests recorded). Together with several other (Red Data) waterbird species that occur in this habitat (see Appendix 1), the Great White Pelican is collision-prone.

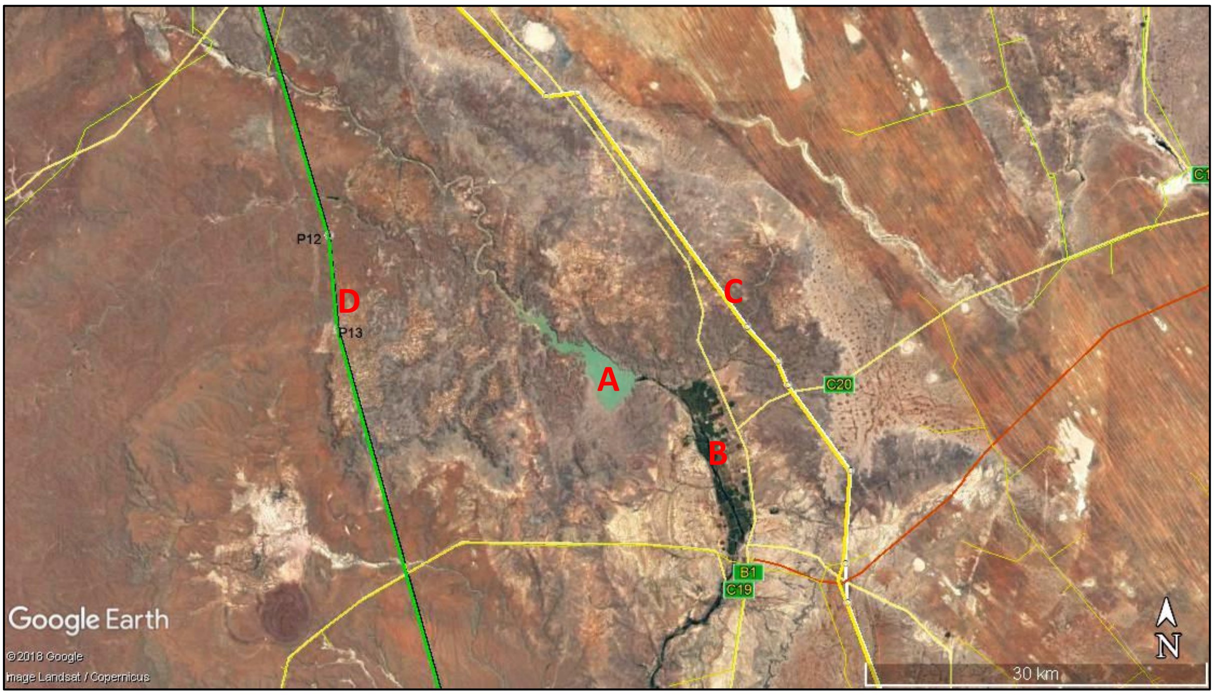

Figure 3. Aquatic and agricultural habitats available to waterbirds at the Hardap Nature Reserve/Dam Important Bird Area, including the Hardap Dam (A) and irrigation developments to the south (B); and the 220 kV power line (dark yellow line, C), existing 400 kV line (dark green line, D) and roads (light yellow) (EIS 2019; based on a Google Earth map).

The associated ephemeral Fish River habitats (Figure 4) are also attractive to waterbirds. The river runs from Central Namibia southwards through the Hardap Dam to the Neckartal Dam and southwards. It is intersected by the existing 400 kV line north and south of the Hardap Dam (at 24° 15' 22.73"S 17° 33' 15.24"E and 25° 4' 59.96"S 17° 46' 15.21"E, respectively). The river also runs close to the 400 kV line (≥2.5 km away) for about 25 km in the Brukkaros area (25° 50' 51.23"S 18° 2' 46.39"E).

The Fish River section of line falls in Dwarf Shrub Savanna (see above, Figure 1), where the topography comprises mainly gravel and rocky undulating plains with low shrubs and grassland. Along the course of the Fish River the topography is rocky and deeply incised. These rocky habitats are also attractive to species such as Black Stork, and various raptors.

Flight paths along the river and including between the Hardap Dam, Neckartal Dam and nearby Naute Dam are likely for waterbirds, including Great White Pelican, given the importance of aquatic habitats in this semi-arid environment. Several of these are Red Data species (see Appendix 1 and 3).

These aquatic habitats near the 400 kV route should thus also be regarded as sensitive in terms of the potential for collisions of waterbirds and other birds including raptors.

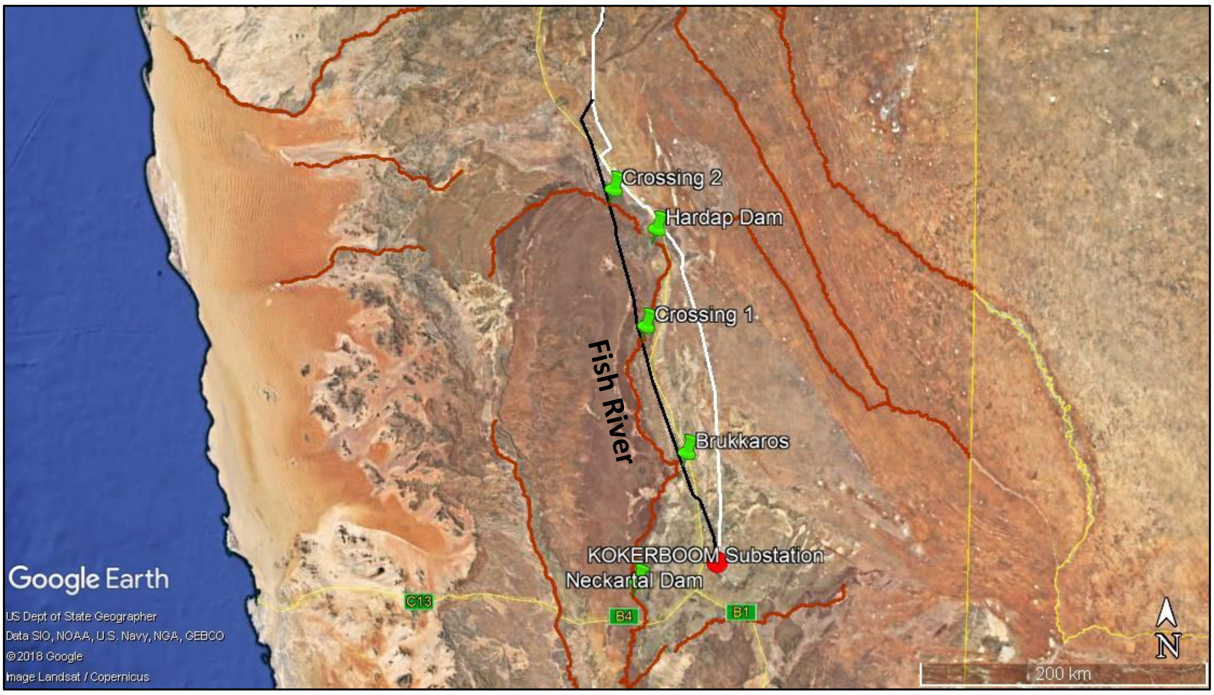

Figure 4. The ephemeral Fish River (brown line, as indicated) runs from Central Namibia southwards through the Hardap Dam to the Neckartal Dam and southwards; it is intersected by the existing 400 kV line (black line) north and south of the dam, and runs close to the line in the Brukkaros area (EIS 2019; based on a Google Earth map).

An indication of numbers of power line-sensitive birds species per quarter degree square (QDS) in the study area, based on the first Southern African Bird Atlas Project (SABAP1) (Harrison et al. 1997), is provided below (Figure 5, EIS 2019). Note the high concentrations of such sensitive species in the north near Auas, and around Mariental area and surrounding areas.

The recorded distribution of individual focal bird species considered at greatest risk to power line collisions in the present study is shown in Appendix 2; the comprehensive maps from Simmons et al. (2015) in this appendix are based on the Namibian Avifaunal Database (NAD; Jarvis et al. 2001; www.biodiversity.org.na), which includes the Namibia Bird Atlas data that was collected at quarter-degree resolution in 1987-1992 and incorporated into SABAP1 (see above); the Namibian wetland bird data set, as well as information from the Namibian nest record scheme and the raptor road count project (Simmons et al. 2015). Available information from the follow-up Southern African Bird

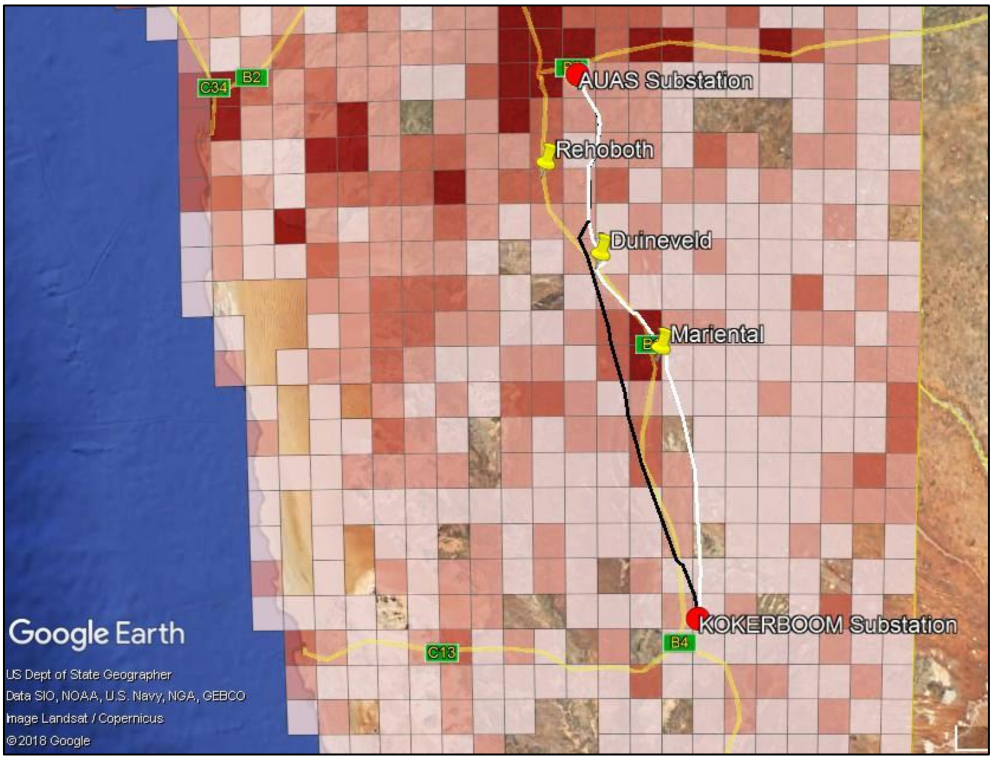

Figure 5. Numbers of power line-sensitive bird species per quarter degree square in the study area (EIS 2019; based on a Google Earth map). Sensitivities range from high (dark red) to very low (pale pink).

Atlas Project (SABAP2) (initiated in South Africa in 2007 and in Namibia in 2012; http://sabap2.adu.org.za) is also included for comparison. The atlas records for the above species are sparse, however, as the South is still relatively under-atlassed at present.

The map for Ludwig's Bustard shows high densities to the west of the study area, medium densities in the central part, and lower densities in the southern part of the study area and to the east. The map for Kori Bustard shows a fairly similar distribution east and west of the study area, with higher densities in the northern part and medium densities in the south. For White-backed Vulture, medium densities are shown for the northern part of the study area and eastwards, with lower densities to the south and west. The map for Great White Pelican indicates localised high density areas in the vicinity of the Hardap Dam and along the Fish River to the south.

Power line mortalities

Recorded power line incidents, 2009-May 2018 in the vicinity of the study area (EIS 2019; NamPower/Namibia Nature Foundation Strategic Partnership database) are shown in Figure 6.

According to the above database, the top five bird collision species/groups in Namibia are flamingos (39%), bustards (28%), korhaans (4%), vultures (3%) and eagles (3%). These species together comprise 487 (77%) of the total of 631 individuals recorded over eight years (2009-2017). Four of the top five are also Red Data species. Bustards are recorded throughout, but in large numbers in the central coastal areas and in the south. Collisions of 11 (Red Data) Great White Pelicans are also on record.

It is not possible to produce cumulative estimates of mortality based on the above data, as not many repeat surveys were completed on the same sections of power line, especially in the South, and the data set also includes incidental records; however, based on 236 dedicated power line surveys covering 5,193 km of varied power line structures throughout Namibia from 2009-2017, a total of

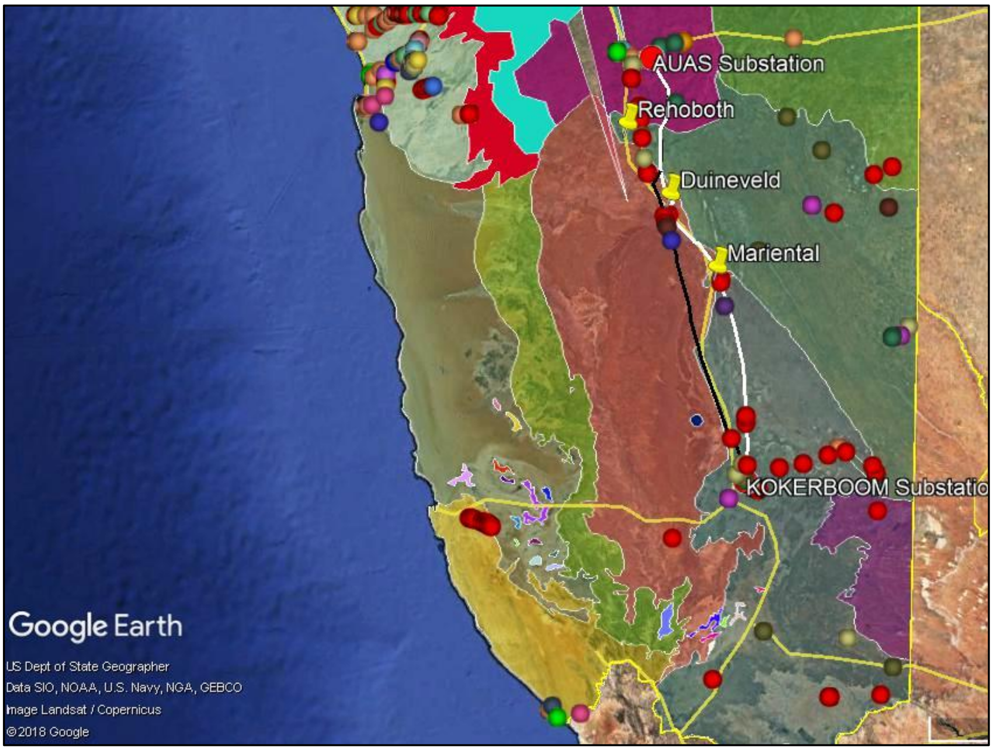

Figure 6. Recorded power line incidents, 2009-May 2018 in the vicinity of the study area (EIS 2019; NamPower/Namibia Nature Foundation Strategic Partnership database; based on a Google Earth map). Red dots = bustard collisions.

450 mortalities produces a mean estimate of 0.09 mortalities/km surveyed (NamPower/ Namibia Nature Foundation Strategic Partnership database 2019; *in litt.* 2019; EIS 2019).

The field surveys conducted in September 2017 (Simmons 2018) yielded the following results, namely 13 bustard carcasses over a distance of 157 km, providing a comparable estimate of 0.08 mortalities/km surveyed, with little difference in the number of mortalities between 220 kV and 400 kV lines. Open grassy habitat was five times more likely to sustain bustard mortalities than Closed Thornveld Thicket; bustard mortalities were highest in the open (Karas Dwarf) shrubland in the south – particularly in open gravel/grassy plains areas.

The (un-adjusted) systematic monitoring data for 325 power line fatalities recorded during 2012-2013 in the Keetmanshoop area (J Pallett *in litt*.) indicated a total estimate of 0.66 fatalities/km/year on the 400 kV line, and of 0.45 fatalities/km/year on the 220 kV line (32% less than the 400 kV line).

Note that the above figures are an estimate of cumulative annual mortality, as they are based on several repeat surveys of each section of power line that were carried out per year; as such, these estimates are not directly comparable with the above estimates (per km surveyed). In this data set eight of the 13 species fatalities recorded were Red Data species; and 246 (76%) of the total fatalities recorded were bustards, predominantly Ludwig's Bustards (133 or 54% of 246).

The forecast in the Avifaunal Assessment Report that the new 462 km 400 kV transmission line could result in a minimum of (462 x 0.66 birds/km/year =) 305 bird mortalities per year, without mitigation is based on the above cumulative estimates (Simmons 2018). In terms of this forecast, 91% (278 bustards and vultures; 231 bustards) are expected to be red data birds.

Examples of relatively high mortality data obtained during recent (once-off) power line surveys in the south is provided below (NamPower/NNF Strategic Partnership, October 2018 *in litt*.):

- Kokerboom-Aries 400 kV, 12 mortalities (including 8 bustards) over 31 km = 0.38 mortalities/km surveyed (Figure 7); and
- Kokerboom-Harib 220 kV, 6 mortalities (including 5 bustards) over 25 km = 0.24 mortalities/km surveyed (Figure 8).

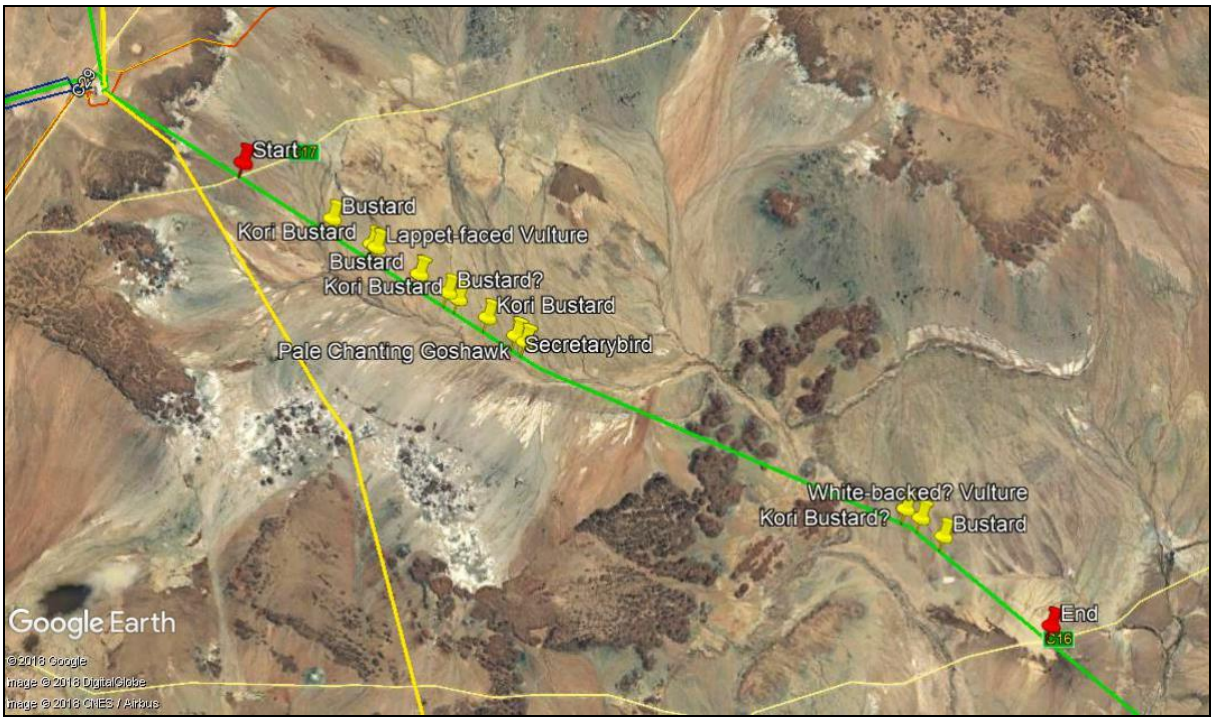

Figure 7. Survey of the Kokerboom-Aries 400 kV line in October 2018: 12 mortalities (including 8 bustards) over 31 km = 0.38 mortalities/km surveyed (NamPower/NNF Strategic Partnership, October 2018 *in litt.*; based on a Google Earth map).

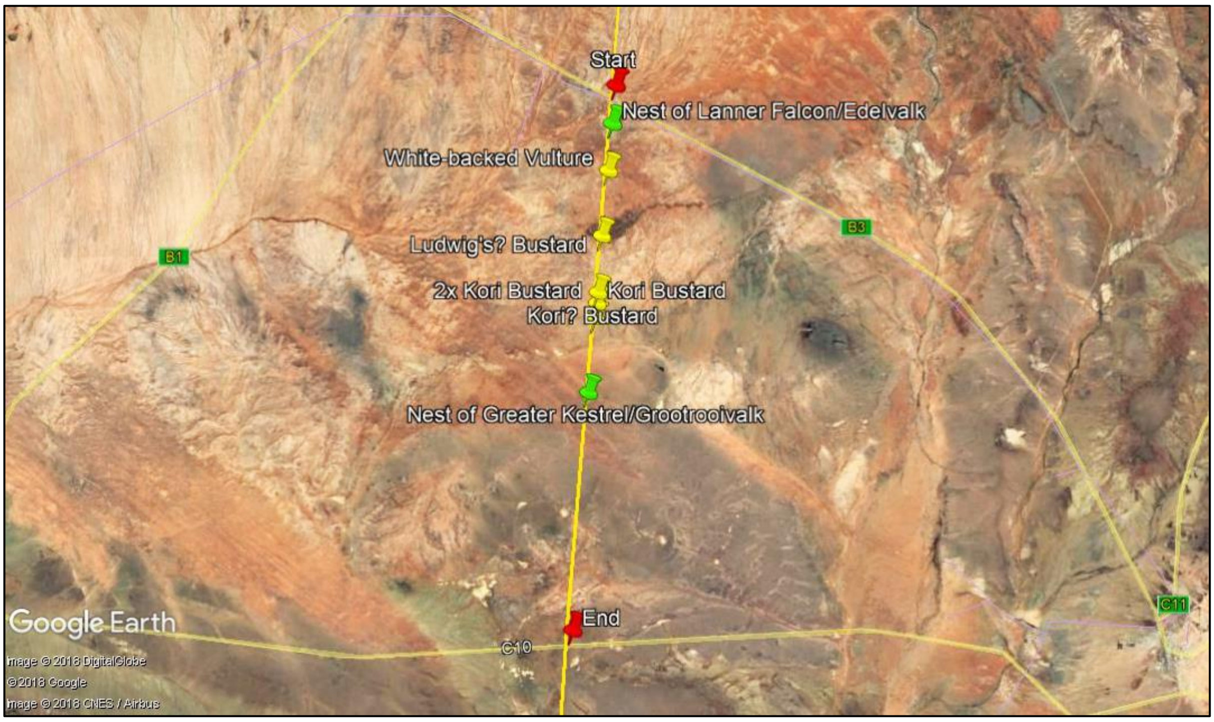

Figure 8. Survey of the Kokerboom-Harib 220 kV in October 2018: 6 mortalities (including 5 bustards) over 25 km = 0.24 mortalities/km surveyed (NamPower/NNF Strategic Partnership, October 2018 *in litt.*; based on a Google Earth map).

Discussion of potential impacts according to the given criteria

The potential impacts are discussed according to the given criteria (see Section No. 1) for the line routes as they are indicated in Figure 1, i.e. the sections north of Duineveld and running through the Southern Kalahari and the Highland Shrubland are identical for both lines (i.e. from 23 37 23.34S 17 26 34.30E northwards); the focus is therefore on the sections of line south of this point, and on power line-sensitive Red Data species.

Is the 400 kV route between Mariental and Keetmanshoop (running along the Fish River) significantly different in risk for birds than the 220 kV route?

Bustards, vultures, eagles are among the top five power line collision species-groups recorded in Namibia to date. In general, power line-sensitive bird species in the study area are fairly evenly distributed within the eastern and western sections of the study area, through which the two proposed alternative 220 kV and 400 kV routes run, respectively. This present discussion focuses on the two bustard species, as being the most prone to collision impacts in the section between Mariental and Keetmanshoop, as well as species associated with the Fish River habitats. The Hardap Dam "hotspot" for waterbirds is discussed separately in the next section below.

The 220 kV route runs through Karas Dwarf Shrubland, where the dominant plant structure is grasslands and low shrubs. This is somewhat more grassy than the low shrub habitats of the Dwarf Shrub Savanna, through which the 400 kV line passes. Grassier habitats appear to be more attractive to bustards, especially after recent rains. Both are omnivores, but Ludwig's Bustard specialises on insects such as grasshoppers and locusts (Hockey et al. 2005). Relatively high densities of Ludwig's Bustards have been recorded to the west of the study area, medium densities in the central part, and lower densities in the southern part and to the east. Kori Bustard shows a fairly similar distribution east and west of the study area, with higher densities in the northern part of the study area and medium densities in the south near Keetmanshoop.

Estimates of around 0.09 power line mortalities/km of power lines surveyed throughout Namibia have been obtained (EIS 2019; NamPower/Namibia Nature Foundation Strategic Partnership 2009-2017; n = 325) and 0.08-0.09/km for the 400 kV and 220 kV power lines surveyed in the study area in 2017 (Simmons 2018; n = 13]). These include high numbers of bustard mortalities in the open (Karas Dwarf) shrubland in the South – particularly in open gravel/grassy plains areas. However, in the case of the Partnership database, the survey effort on the existing 400 kV line between Keetmanshoop and the Mariental area is considered relatively low. In essence, current results indicate that collisions are taking place on most sections of power line that have been surveyed in bustard distribution areas. Little difference was found in the number of mortalities between 220 kV and 400 kV lines in 2017 (Simmons 2018), although recent survey data by the Partnership (2018) found higher mortalities for a 400 kV line (n = 21) than for a 220 kV line (n = 6). More intensive, systematic monitoring for the South in 2012-2013 (J Pallett *in litt*.; n = 325) has provided a high, cumulative estimate of 0.66 mortalities/km/year on a 400 kV line, and 45 mortalities/km/year (32% less) on a 220 kV line. Eight of the 13 species have Red Data status, and 76% of the total fatalities recorded were bustards, predominantly Ludwig's Bustards. Provisional extrapolations from these data predict high numbers of mortalities for the lines in these areas.

It has been shown that the majority of bustard collisions (89%) occur away from the towers themselves, and the Avifaunal Assessment Report (Simmons 2008) therefore recommends a staggered pylon alignment, to maximise the visibility of the combined power lines. The towers for the existing 220 kV line are 35 m high, whereas those for the existing and proposed 400 kV line are slightly higher (38-44 m high). The span lengths for the 220 kV line are 420 m, compared to 450 m for the 400 kV lines. The natural staggering effect resulting from the above differences in span length in the combination of a 220 kV line and the new 400 kV line could thus, in theory, increase the visibility of these combined lines, although it could be argued that this could also potentially increase the collision risk as the cables (conductors, optical fibre ground wires and earth wires) would all be at different heights on the two structures, especially at mid-span, thereby increasing the potential density of the barrier presented to flying birds – both to bustards as well as other species. In the case of two parallel 400 kV lines, the tower height and the span length would be the same, and any staggering of the pylon alignment would mostly need to be achieved by design (while taking into account technical constraints). The possibility of increased collision risk, as mentioned above, would be similar for both combinations.

There is no difference between the minimum distance between a 400 kV line and a 220 kV line, or between two 400 kV lines, namely 45 m, measured between the centrelines, and this is not likely to be a factor in terms of relative visibility of the two proposed alternatives.

In this section of the power line, the habitats particularly at risk would be open grassy and gravel plains; and drainage lines bustard habitat (see Appendix 1). The Fish River and its associated aquatic habitats would also be potentially sensitive where they are close to the 400 kV line, in terms of the potential for collisions of waterbirds and other birds, including raptors.

Although, in theory, sections of power line that remain sensitive even after staggering has been incorporated could be identified through follow-up monitoring and then mitigated by means of marking, the technical/practical and financial constraints of retrospective *vs* proactive fitting of such mitigation are an important consideration.

The 400 kV route also runs close to or across the ephemeral Fish River in several localities. The general topography in this section comprises mainly gravel and rocky undulating plains with low shrubs and grassland; along the course of the river the topography is rocky and deeply incised. Apart from waterbirds, these rocky habitats are also attractive to species such as Black Stork, and various raptors. Given the importance of aquatic habitats in this semi-arid environment, flight paths along the river and including between the Hardap Dam, Neckartal Dam and nearby Naute Dam are likely, including for Great White Pelican and other Red Data species. These aquatic habitats near the 400 kV route should thus also be regarded as sensitive in terms of the potential for collisions of waterbirds and other birds including raptors.

Summary:

- Both Ludwig's Bustard and Kori Bustard have been recorded in the habitats through which both route alternatives run; however, the Karas Dwarf Shrubland on the 220 kV route is relatively grassier, and more likely to be preferred by bustards
- High numbers of bustard mortalities have been recorded in open (Karas Dwarf) shrubland, particularly on the 220 kV route; however, the overall survey effort is considered lower on the 400 kV route, and there is no confirmed difference in mortality rates between the existing 220 kV and 400 kV lines; current results collectively indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas
- There would be a greater natural staggering effect in a 220 kV/400 kV combination, which in the 400 kV/400 kV combination would mostly need to be achieved by design as span lengths would be practically the same; however, although staggering could increase visibility of the power line structures, it could also potentially increase the collision risk, as cables (conductors, optical fibre ground wires and earth wires) would all be at different heights on the two structures, especially at midspan, thereby increasing the potential density of the barrier presented to all flying birds.
- The Fish River and its associated aquatic habitats on the 400 kV route should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds.

Is the 400 kV route at the Hardap Dam significantly less of a risk to birds than the 220 kV route in the same area? and

Is there a significant difference in cumulative impact on birds between the two routes at the Hardap Dam?

Both routes fall within Dwarf Shrub Savanna in this section near the Hardap Dam, although the 220 kV route borders on Southern Kalahari to the east, which is closer to camel thorn tree *Acacia erioloba* habitats frequented by vultures.

A concentration of waterbird species is associated with the Hardap Nature Reserve/Dam Important Bird Area (IBA) near Mariental (Figure 3), including a localised high density of (Red Data) Great White Pelican breeding on the islands, as well as several other (Red Data) waterbird species (see below). These aquatic habitats are particularly important in this relatively semi-arid region. Extensive agricultural irrigation schemes south of the dam are attractive to a variety of birds (e.g. migrant White Storks, and Kori Bustards pers. obs.). The associated ephemeral Fish River, to the south, is also attractive to waterbirds, raptors and other birds (see above).

The Cross-Rope Suspension Tower structures are not considered attractive for larger birds to perch on; however, the strain towers at bend points may be attractive for birds to sit on top of the structures. Fortunately, the number of bend points on either power line route is relatively limited (only 2-5 points) in the Hardap Dam area (Figure 3), although such structures should receive special attention during monitoring.

Electrocutions are, however, considered unlikely on 400 kV lines, as the nature of the structure and the way the conductor is supported results in approximately 3.0 meters of clearance between different phase conductors and the structure (Lehman et al. 2007; K Nghitevelekwa & M van der Merwe NamPower, pers. comm.). The risk of short circuits due to streamers is therefore also considered lower than on lower voltage lines, where this clearance is much less. It is sometimes found that smaller birds (e.g. Sociable Weaver) make nests in some structures.

Great White Pelican, together with at least 10 other Red Data waterbird species in this habitat (Appendix 1), is prone to collisions on power line structures. These include African Fish-eagle (*Vulnerable*), Greater Flamingo (*Vulnerable*), Black Stork (*Endangered*), Black-necked Grebe (*Near Threatened*) and Maccoa Duck (*Near Threatened*). Newly fledged birds (including Great White Pelican) are at particular risk. Many waterbird species fly at night, or under conditions of poor light, increasing the collision risk.

The 220 kV route is about 12 km from the dam and the irrigation schemes to the south of the dam, whereas the 400 kV line is at least 22 km away. The irrigation developments are <10 km away from the 220 kV route in places, and >30 km away from the 400 kV route. Flightpaths are possible between the dam and a number of ephemeral pans (when filled with water) to the north-east of the dam, as well as a few pans/dams to the south-west. When active, the abattoir (situated near the sewage ponds) at Mariental is also a potential attractant to Marabou Stork and White-backed Vulture. The proximity of the 220 kV route to the above attractants is, however, mitigated in part by being closely aligned with the busy B2 road route.

The collision risk in this section of power line should, however, not be underestimated.

In this section of the power line, the habitats particularly at risk would be the above aquatic habitats and irrigation areas. The identified vulture breeding and feeding area (43 km north of Kalkrand) also has the potential for collision and other impacts and should be avoided if possible.

The cumulative impact on birds in the Hardap Dam area, when compared between the two routes, is likely to be lower in the case of the 400 kV line, for the reason that it is double the distance away from the dam than the 220 kV line which would, in theory, reduce the likelihood of collisions by birds on potential related flightpaths.

Summary:

- A concentration of waterbirds, including 10 Red Data species, is associated with the Hardap Nature Reserve/Dam Important Bird Area, which includes an important breeding area for Great White Pelican
- Electrocutions and short circuits due to streamers are considered unlikely on the 400 kV structure, but there is a high risk of waterbird collisions
- The 220 kV route is closer to the dam and its irrigation schemes than the 400 kV route, and more likely to lie on potential flightpaths between the dam and other associated habitats; the 220 kV route is also closer to another potential attractant, the Mariental abattoir (when active) and sewage ponds
- The cumulative impact on birds between the two routes at Hardap Dam is likely to be relatively lower in the case of the 400 kV line, as it is double the distance away from the dam than the 220 kV line (12 km vs 22 km) which would, in theory, reduce the likelihood of collisions by birds on related flightpaths.

Will it make a material difference to the impact on birds if the existing 220 kV route is used instead of the existing 400 kV route?

- High numbers of Ludwig's Bustard and Kori Bustard collisions have been recorded in the open (Karas Dwarf) shrubland/220 kV route; however, the survey effort has been lower on the 400 kV line, and current results indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas
- There would be a greater natural staggering effect in a 220 kV/400 kV combination, which in the 400 kV/400 kV combination would mostly need to be achieved by design as span lengths are the same; however, the collision risk for either combination could also potentially be increased by staggering, as cables (conductors, optical fibre ground wires and earth wires) would be at different heights on the two structures, especially at midspan, thereby increasing the potential density of the barrier presented to all flying birds
- A high concentration of waterbird, including at least 10 Red Data species, is associated with the Hardap Nature Reserve/Dam Important Bird Area, with a high risk of waterbird collisions
- The 220 kV route is closer to the dam and irrigation schemes (and other potential attractants) than the 400 kV route, and more likely to lie on potential bird flightpaths
- The cumulative impact on birds between the two routes at Hardap Dam is therefore likely to be relatively lower in the case of the 400 kV line, as it is further away from the dam
- The Fish River and its associated aquatic habitats on the 400 kV line route should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds.

4. Conclusions

Enviro Dynamics Environmental Management Consultants has been appointed to evaluate the current status on the EIA process for the new 400 kV transmission line from Auas Substation at Windhoek in Central Namibia to Kokerboom Substation at Keetmanshoop in Southern Namibia, as was conducted by Lithon Project Consultants.

The client has requested an objective review of the opinion in the Avifaunal Assessment Report (Simmons 2018) in a very specific way with regard to two alternative routes, respectively following the existing 220 kV and existing 400 kV route. The review is to be conducted according to the following criteria/Terms of Reference:

- Will it make a material difference to the impact on birds if the existing 220 kV route is used instead of the existing 400 kV route?
- Is the 400 kV route at the Hardap Dam significantly less of a risk to birds than the 220 kV route in the same area?
- Is there a significant difference in cumulative impact on birds between the two routes at the Hardap Dam?
- Is the 400 kV route between Mariental and Keetmanshoop (running along the Fish River) significantly different in risk for birds than the 220 kV route?

After due consideration of the Avifaunal Assessment Report and other available information, the findings of the review are as follows:

- High numbers of Ludwig's Bustard and Kori Bustard collisions have been recorded in the open (Karas Dwarf) shrubland/220 kV route; however, the survey effort has been lower on the 400 kV line, and current results indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas
- Apart from the revised alignment of the new power line route, the Avifaunal Assessment Report has also recommended a staggered pylon design as one of the primary mitigations. The review has found that there would be a greater natural staggering effect in a 220 kV/400 kV combination, which in the 400 kV/400 kV combination would mostly need to be achieved by design as span lengths are the same; however, the collision risk for either combination could also potentially be increased by staggering, as cables (conductors, optical fibre ground wires and earth wires) would be at different heights on the two structures, especially at midspan, thereby increasing the potential density of the barrier presented to all flying birds
- A high concentration of waterbirds, including at least 10 Red Data species, is associated with the Hardap Nature Reserve/Dam Important Bird Area, with a high risk of waterbird collisions
- The 220 kV route is closer to the dam and irrigation schemes (and other potential attractants) than the 400 kV route, and more likely to lie on potential bird flightpaths
- The cumulative impact on birds between the two routes at Hardap Dam is therefore likely to be relatively lower in the case of the 400 kV line, as it is further away from the dam
- The Fish River and its associated aquatic habitats on the 400 kV line route should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds.

Acknowledgements

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Appendix 1. Comparative summary of habitat types, details of bird species of concern and environmental sensitivities/ high risk areas for the proposed new 400 kV Kokerboom-Auas power line

KEY:
Red Data status (Simmons *et al*. 2015; Brown et al. 2017; Simmons 2018) CE = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened (remaining species LC = Least Concern); Occurrence: R = rare; U = uncommon; C = common; LC = locally common; italics = lower priority
Namibian near-endemic species = 90% of population in Namibia (Simmons *et al.* 2015; Brown et al. 2017)

References: [1] = after Simmons & Martins 2017; [2] = after Simmons 2018; [3] = NamPower/NNF Strategic Partnership database (2009-2017; EIS 2019) + *in litt* 2018; Simmons (2018) and Pallett survey data excluded as habitats are not confirmed; [4] = added during review (including species in red)

Section of transmission line and approx. distance (km)[2]	Biome and vegetation type[2]	No. of bird atlas survey visits (SABAP1) and details of bird species[2]	Red Data and Namibian near-endemic species of concern[1] and their occurrence (red[4])	Power line incidents on record[3]	Environmental sensitivities / high risk areas[1, 2]	Further environmental sensitivities / high risk areas[4]
Kokerboom to Mariental **(205 km)**	Nama Karoo - Karas Dwarf Shrubland	No of atlas survey visits: 41 No. of bird species: 113 No. Red Data species: 8 No. Namibian endemics: 0 No. southern African endemics: 41	Ludwig's Bustard VU (R) Kori Bustard NT (C) White-backed Vulture EN (U) Lappet-faced Vulture VU (R) Booted Eagle EN (R) Martial Eagle EN (U) Verreauxs' Eagle NT (C) Secretarybird VU (U) Greater Flamingo VU (R) Lesser Flamingo VU (R)	44 bustards 15 raptors 2 flamingos (4 raptor electrocutions)	- Open grassy and gravel plains; drainage lines: bustard habitat	• **220 kV route**: all Karas Dwarf Shrubland (205 km) • **400 kV route**: edge of Karoo Dwarf Shrubland (146 km), and Dwarf Shrub Savanna (65 km)

PTO

Section of transmission line and approx. distance (km)[2]	Biome and vegetation type[2]	No. of bird atlas survey visits (SABAP1) and details of bird species[2]	Red Data and Namibian near-endemic species of concern[1] and their occurrence (red[4])	Power line incidents on record[3]	Environmental sensitivities / high risk areas[1, 2]	Further environmental sensitivities / high risk areas[4]
Mariental to Duineveld **(142 km)**	Nama Karoo - Dwarf Shrub Savanna (eastern edge)	No of atlas survey visits: 193 No. of bird species: 200 No. Red Data species: 12 No. Namibian endemics: 1 No. southern African endemics: 63	Ludwig's Bustard VU (U) Kori Bustard NT (U) Cape Vulture CE (R) White-backed Vulture EN (U) Lappet-faced Vulture VU (R) Tawny Eagle EN (R) Booted Eagle EN (U) Martial Eagle EN (U) Verreauxs' Eagle NT (U) Black Harrier EN (R) Pallid Harrier (NT) (U) Secretarybird VU (R) African Fish-Eagle (VU) (U) Black Stork (EN) (U) Black-necked Grebe (NT) (U) *Caspian Tern (VU) (R)* *Chestnut-banded Plover (NT) (R)* Great White Pelican VU (LC) Greater Flamingo (VU) (U) Lesser Flamingo (VU) (U) Maccoa Duck (NT) (U) Rufous-bellied Heron (NT) (R) Marabou Stork NT (R) *Sclater's Lark NT (R)* **NE to Namibia:** Damara Hornbill (R)	9 bustards 2 raptors 1 heron	- Hardap Dam and wetland birds that may impact on the line - Open grassy and gravel plains S of Kalkrand; drainage lines: bustard habitat - East of Mariental: probable Verreaux's Eagle nest?	• **220 kV route**: Mostly Dwarf Shrub Savanna (some parts on edge of Southern Kalahari) (142 km) – Closer to irrigation develop-ments south of dam (<10 km) – Abattoir at Mariental: attractant to vultures and Marabou Stork (when active) – 12 km NE of Hardap Dam: many ephemeral pans • **400 kV route**: all Dwarf Shrub Savanna – >30 m away from irrigation developments – 22 km W of Hardap: a few pans/dams **Hardap Nature Reserve/Dam:** Important Bird Area (IBA) >0.5% of biogeographic population of congregatory waterbird species, i.e. Great White Pelican; main breeding site in Namibia (up to 250 nests); many other (Red Data) waterbird species that are collision-prone Associated ephemeral Fish River is also attractive to waterbirds, raptors and other birds

Section of transmission line and approx. distance (km)[2]	Biome and vegetation type[2]	No. of bird atlas survey visits (SABAP1) and details of bird species[2]	Red Data and Namibian near-endemic species of concern[1] and their occurrence (red[4])	Power line incidents on record[3]	Environmental sensitivities / high risk areas[1, 2]	Further environmental sensitivities / high risk areas[4]
Duineveld to Rehoboth **(43 km)**	Acacia Tree-and-shrub Savanna - Southern Kalahari (western edge)	No of atlas survey visits: 16 No. of bird species: 117 No. Red Data species: 8 No. Namibian endemics: 0 No. southern African endemics: 33	Ludwig's Bustard VU (U) Kori Bustard NT (U) White-backed Vulture EN (C) Lappet-faced Vulture VU (C) Tawny Eagle EN (R) Martial Eagle EN (U) Secretarybird VU (U) Greater Flamingo VU (R) Marabou Stork NT (R) Rüppell's Parrot NT (C)	2 bustards 2 raptors (6 raptor electrocutions)	- Vulture breeding and feeding areas 43 km N of Kalkrand and northwards - Sensitive perennial pans / avifauna hotspot: Farm Wiese	- 11 Kori Bustards and 26 Ludwig's Bustards, included in many bird species ringed on farm Wiese (J Kemper 2016)
Rehoboth to Auas **(77 km)**	Acacia Tree-and-shrub Savanna - Highland Shrubland	No of atlas survey visits: 57 No. of bird species: 177 No. Red Data species: 11 No. Namibian endemics: 7 No. southern African endemics: 41	Kori Bustard NT (R) White-backed Vulture EN (U) Lappet-faced Vulture VU (U) Tawny Eagle EN (U) Martial Eagle EN (R) Verreauxs' Eagle NT (U) Black Harrier EN (R) Secretarybird VU (U) Marabou Stork NT (R) Rüppell's Parrot NT (C) Violet Woodhoopoe EN (R) **NE to Namibia:** Rüppell's Parrot (U) Violet Woodhoopoe (R) Damara Hornbill (R) Monteiro's Hornbill (R) *Carp's Tit (R)* *Rockrunner (U)* *White-tailed Shrike (U)*	4 bustards 3 raptors 2 flamingos (3 raptor electrocutions)	- Verreaux's Eagle: two nests on farm Volmoed, 13 km west of Dordabis (two nests) - Vulture breeding areas on farms Klipvlei (70 km south of Auas SS), and farm Wilderness (135 km S of Auas SS)	

Appendix 2. Proposed power line /tower structures

(K Nghitevelekwa and M van der Merwe, NamPower pers. comm. September 2019)

PTO for photographs (supplied by NamPower)

Tower type	Scope	Complexity (Steelwork)	Construction effort	Cost	Footprint
Strain tower	• Used at turning points of up to 60 degrees.	High	High	• High • Slightly more than double the self-supporting suspension tower	Less
Self-supporting suspension tower	• Used at turning points: 0 to 30 degrees, • Used, together with other types of towers, where there are servitude constraints.	Medium	Medium	• Medium • Slightly more than double the cross rope suspension tower	Less
Cross rope suspension tower	• Used at all straight sections of the transmission line where servitude constraint is not an issue.	Low	Low	• Low	Large

Self Supporting & Cross Rope Suspension Towers

400 kV Cross Rope Suspension Towers

Straight Sections

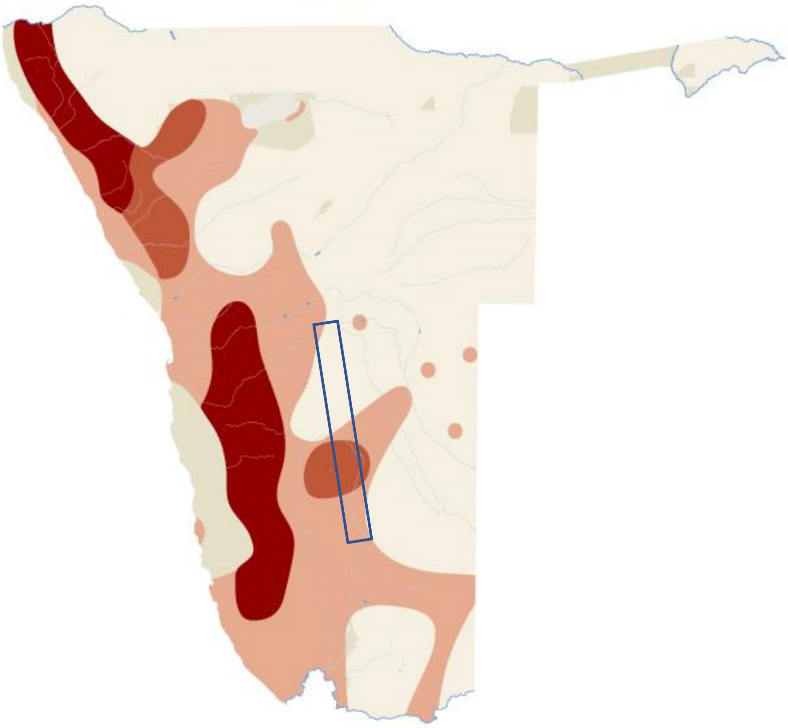

Self-supporting Suspension Tower

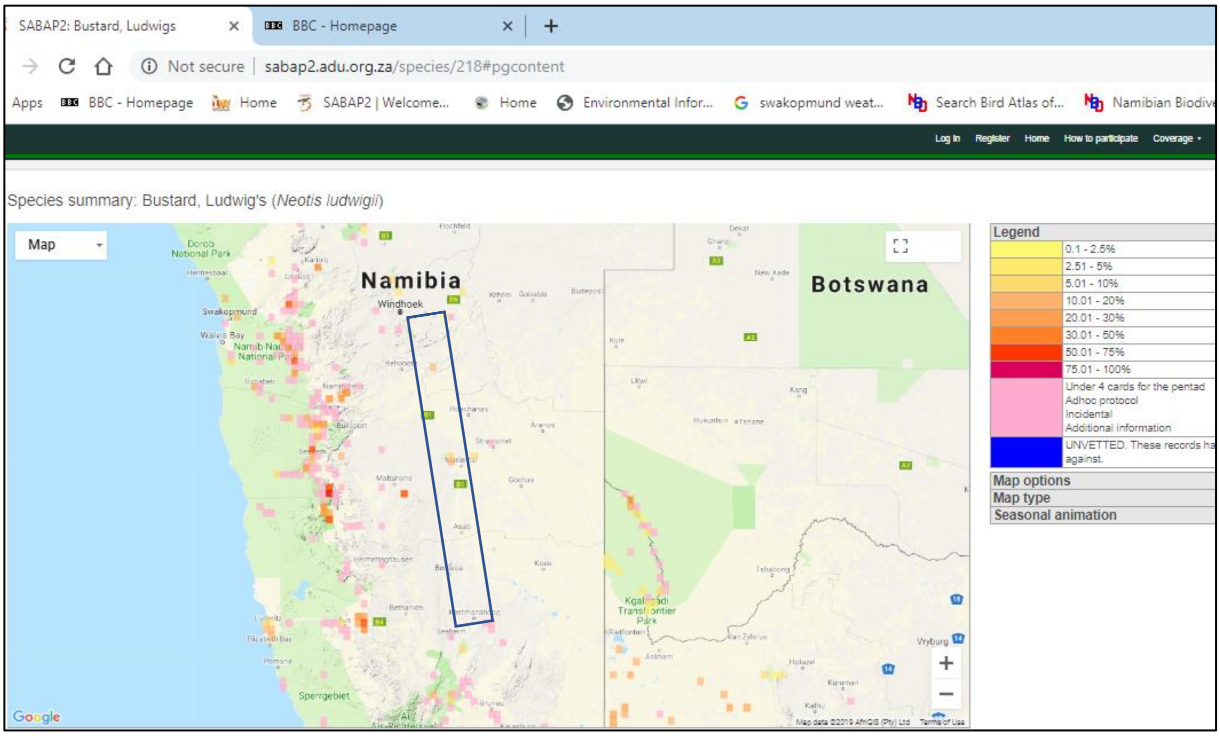

Strain Tower

Appendix 3. Distribution maps for focal bird species

Ludwig's Bustard

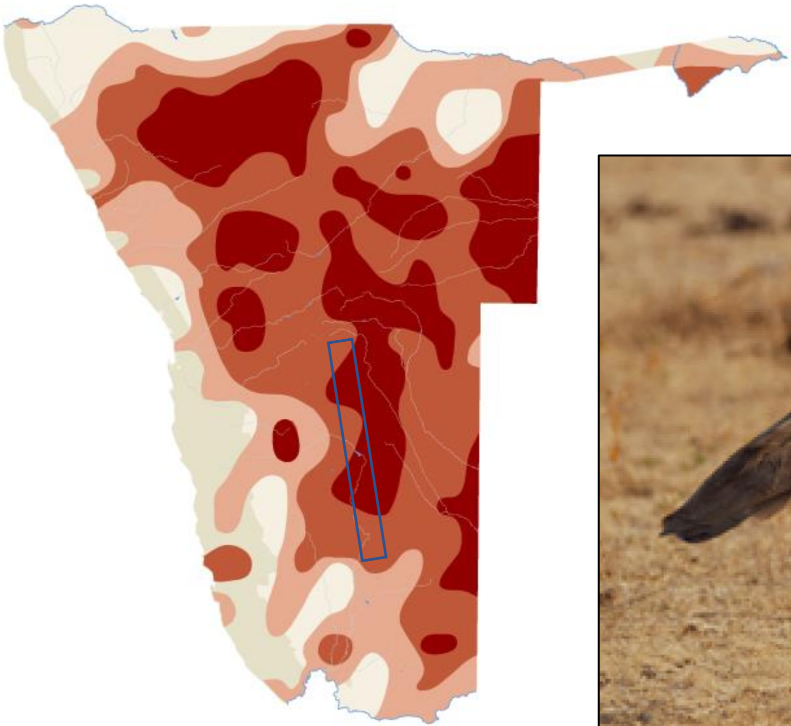
(Map & photo above: Simmons et al. 2015; map below: more recent SABAP2 data
Approximate study area indicated by blue box)

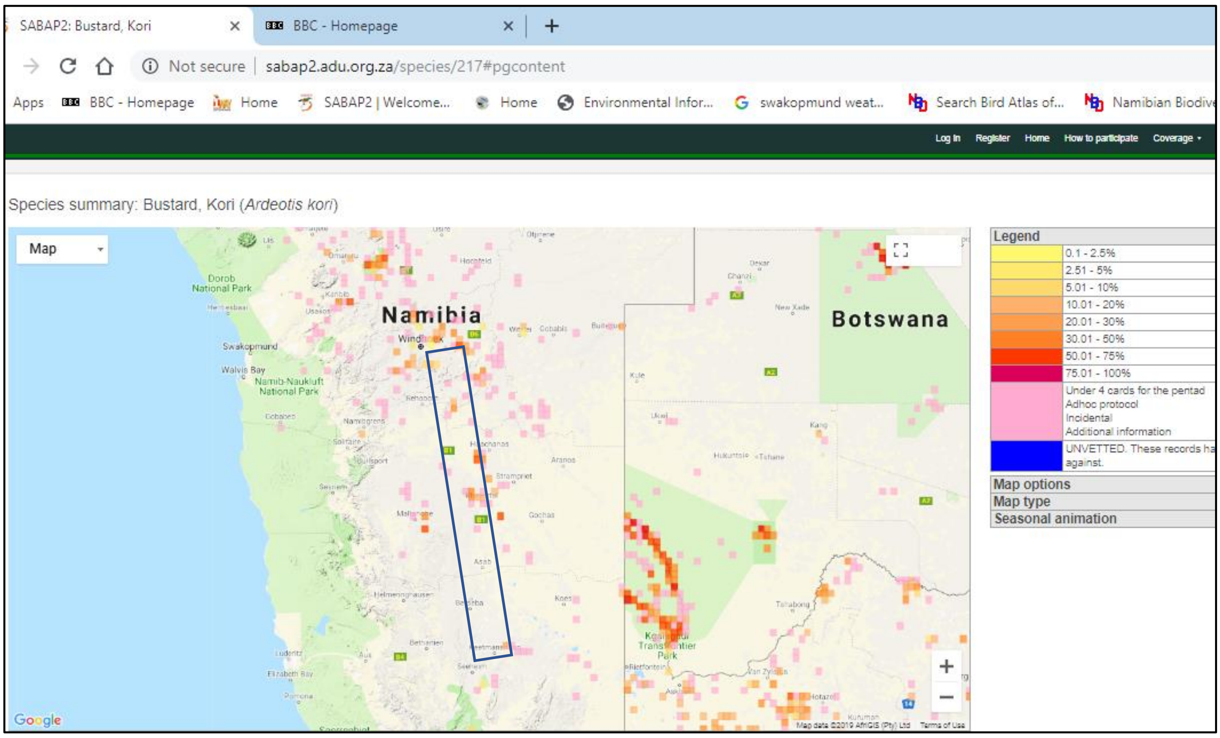




Kori Bustard

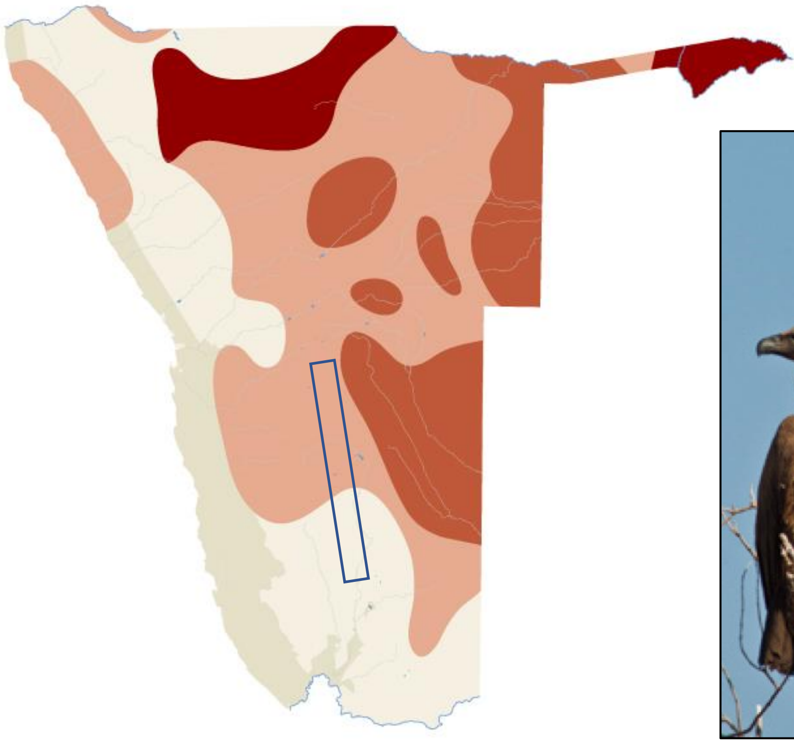
(Map & photo above: Simmons et al. 2015; map below: more recent SABAP2 data
Approximate study area indicated by blue box)

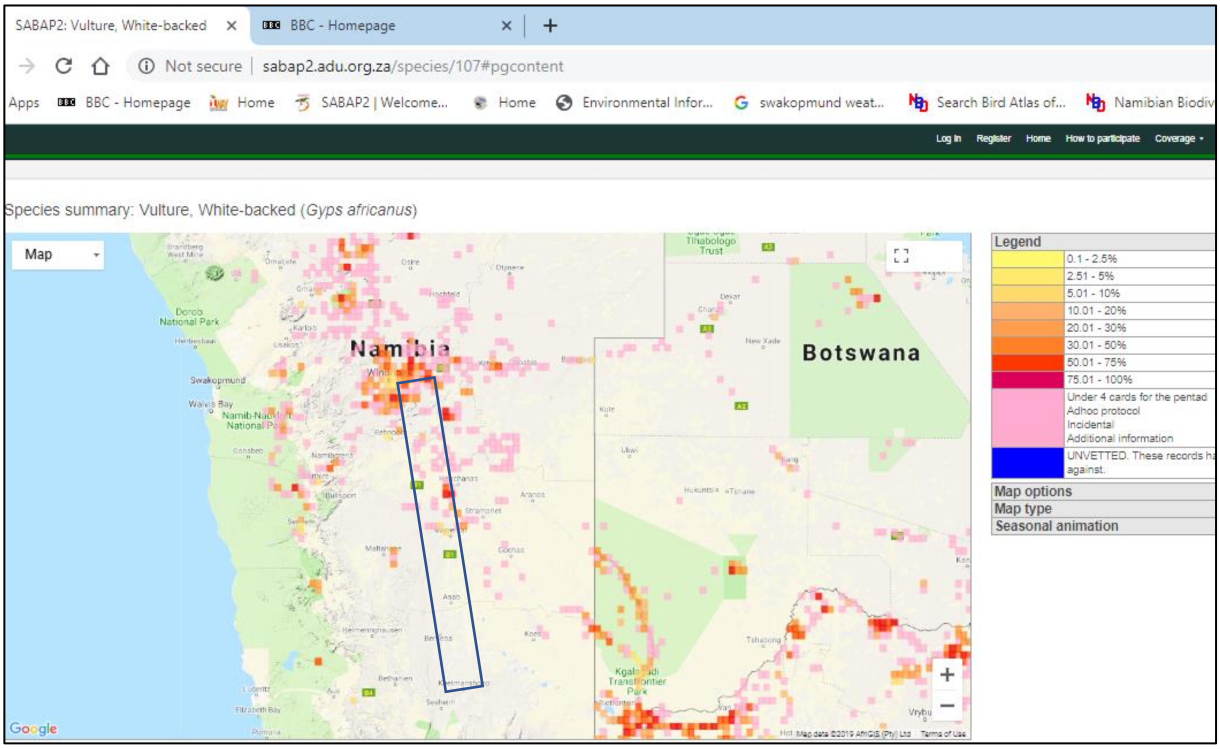




White-backed Vulture

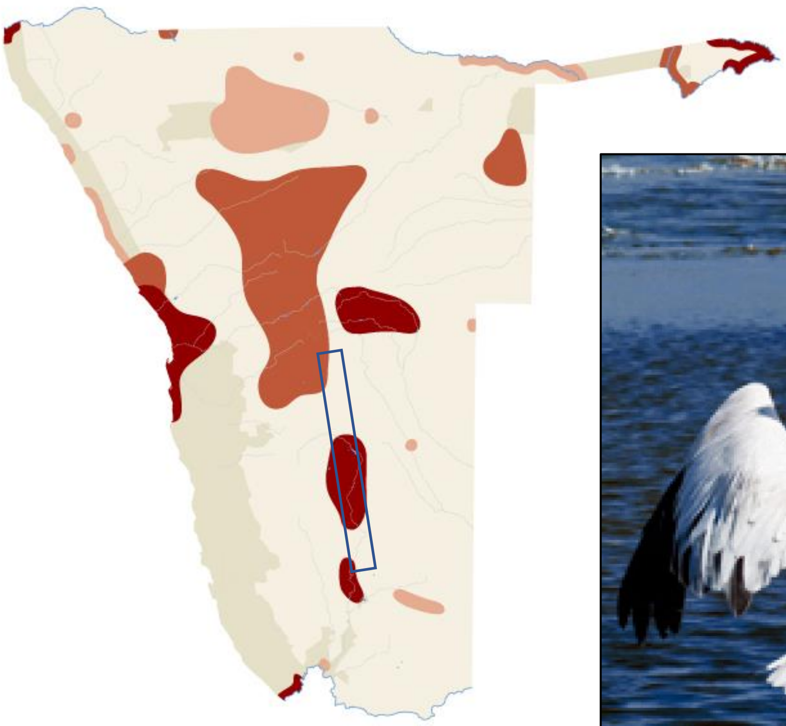
(Map & photo above: Simmons et al. 2015; map below: more recent SABAP2 data
Approximate study area indicated by blue box)

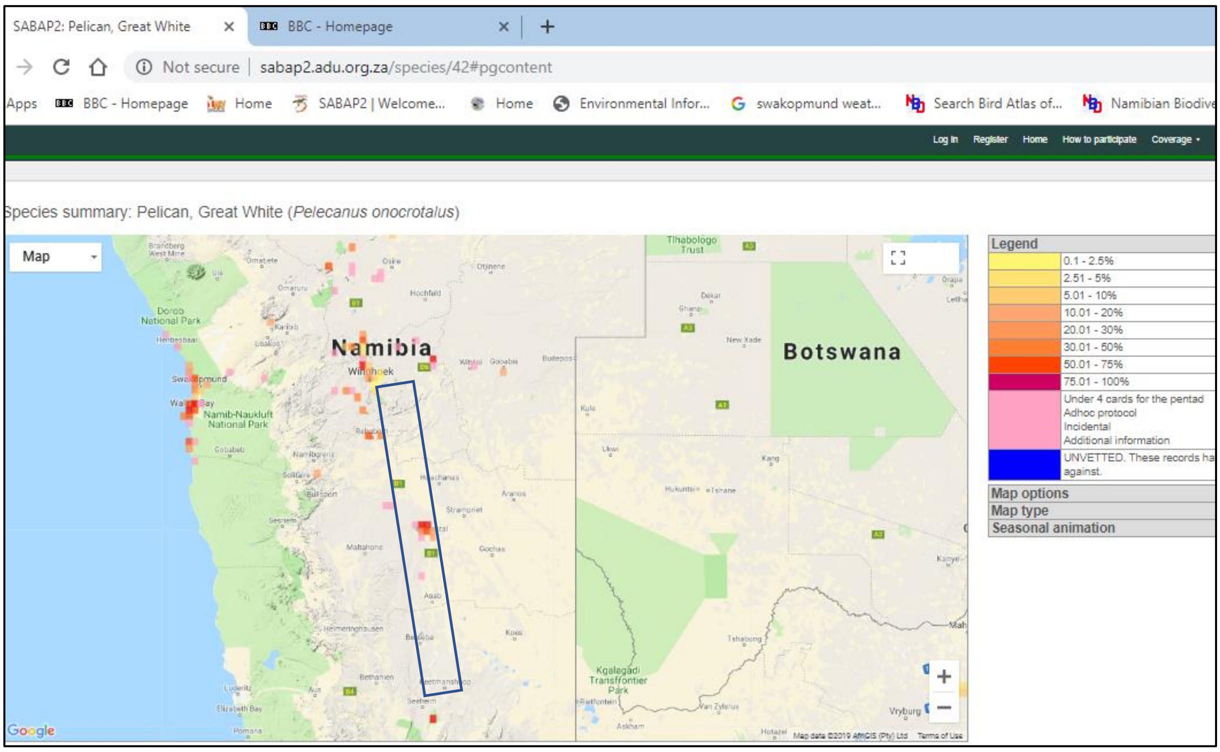




Great White Pelican

(Map & photo above: Simmons et al. 2015; map below: more recent SABAP2 data
Approximate study area indicated by blue box)



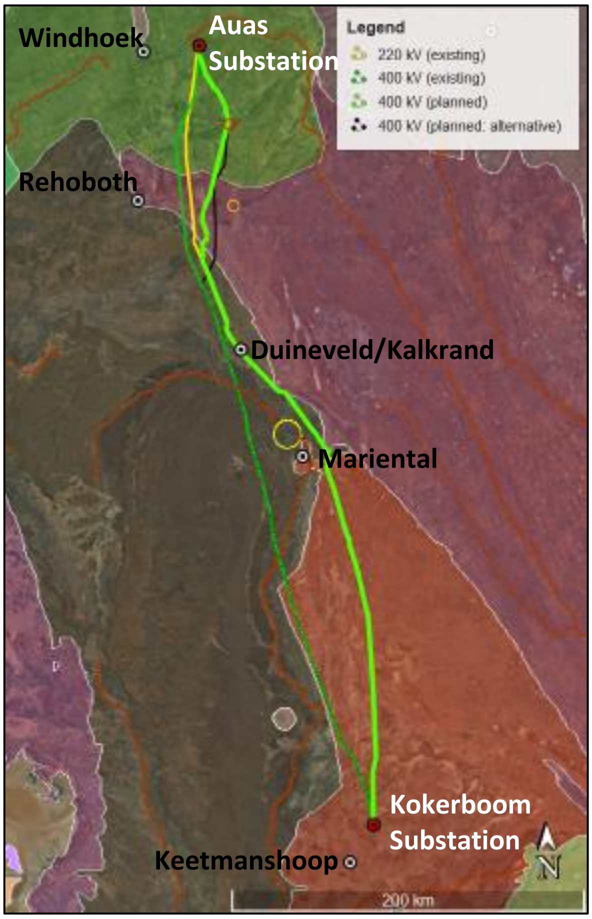


Appendix 4. Scientific names of bird species mentioned in the review

Common name	Scientific names
African Fish-eagle	*Haliaeetus vocifer*
Black Harrier	*Circus maurus*
Black Stork	*Ciconia nigra*
Black-chested Snake-eagle	*Circaetus pectoralis*
Black-necked Grebe	*Podiceps nigricollis*
Booted Eagle	*Hieraaetus pennatus*
Cape Vulture	*Gyps coprotheres*
Carp's Tit	*Parus carpi*
Caspian Tern	*Hydroprogne caspia*
Chestnut-banded Plover	*Charadrius pallidus*
Damara (Red-billed) Hornbill	*Tockus damarensis*
Great White Pelican	*Pelecanus onocrotalus*
Greater Flamingo	*Phoenicopterus ruber*
Kori Bustard	*Ardeotis kori*
Lappet-faced Vulture	*Torgos tracheliotos*
Lesser Flamingo	*Phoeniconaias minor*
Ludwig's Bustard	*Neotis ludwigii*
Maccoa Duck	*Oxyura maccoa*
Marabou Stork	*Leptoptilos crumenifer*
Martial Eagle	*Polemaetus bellicosus*
Monteiro's Hornbill	*Tockus monteiri*
Pallid Harrier	*Circus macrourus*
Rockrunner	*Achaetops pycnopygius*
Rufous-bellied Heron	*Ardeola rufiventris*
Rüppell's Parrot	*Poicephalus rueppellii*
Sclater's Lark	*Spizocorys sclateri*
Secretarybird	*Sagittarius serpentarius*
Sociable Weaver	*Philetairus socius*
Tawny Eagle	*Aquila rapax*
Verreaux's Eagle	*Aquila verreauxii*
Violet Woodhoopoe	*Phoeniculus damarensis*
White-backed Vulture	*Gyps africanus*
White-tailed Shrike	*Lanioturdus torquatus*

Environmental and Social Assessment for the Auas – Kokerboom 400 kV Transmission Line, Namibia

Draft Biodiversity Report and Critical Habitat Assessment



Prepared by:

African Conservation Services cc

Prepared for:

Enviro Dynamics

November 2023

Name of project	**Environmental Impact Assessment for the Auas – Kokerboom 400 kV Transmission Line, Namibia** **Biodiversity Report and Critical Habitat Assessment**
Principal client	NamPower Windhoek, Namibia
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Report version and date	Draft 1: 25 October 2023 Draft 2: 3 November 2023 Final Draft: 16 November 2023

Executive summary

Background to the project

The national power utility of Namibia, NamPower intends to construct a 400 kV power line from the Kokerboom Substation, near Keetmanshoop in the south, to the Auas Substation, about 40 km from Windhoek in the north. The planned 461 km Auas – Kokerboom 400 kV Transmission Line is for the benefit of the Namibian electricity transmission backbone and Namibian economy.

NamPower has submitted a request to the World Bank to fund the construction of the new Auas - Kokerboom 400 kV Transmission Line. To meet the requirements of the World Bank Environmental and Social Framework (WB ESF; World Bank 2016), NamPower is required to update and supplement the ESIA and ESMP in addition to other supporting documents to meet the requirements of the WB ESF.

To meet the objectives of ESS 6, "Biodiversity Conservation and Sustainable Management of Living Natural Resources"[1], a Biodiversity and Critical Habitat Assessment was undertaken for the proposed new 400 kV transmission line. To identify and assess the areas of Critical Habitat along the transmission corridor, a Critical Habitat Area of Analysis (CHAA) was defined. A CHAA of 60-100 km on either side of the planned and alternative power line servitudes was considered as a broad, focal CHAA, to gain an understanding of the relative importance/uniqueness of the CHAA on a regional (or even global) scale for birds and vegetation, rather than focusing only on the narrow project site itself. Within the CHAA, specific potentially sensitive areas/features with a higher biodiversity value, that allow for a more well-defined habitat demarcation, have been considered. Areas of potential sensitivity include breeding sites/areas for White-backed Vulture and Verreaux's Eagle, wetland habitats including the Hardap Nature Reserve Important Bird Area (IBA) with the Hardap Dam and its associated irrigated areas, and the ephemeral Fish River catchment. The findings from the Biodiversity and Critical Habitat Assessment report feed into the ESIA report. A detailed Biodiversity Management Plan, which sets out the long-term monitoring requirements for this project, will be prepared once additional information as highlighted in this report has been obtained. The additional information will supplement and verify the robustness of the proposed mitigation measures while also confirming and further defining the areas of particular concern which have been identified in this report.

Results of Critical Habitat Assessment:

Habitat and vegetation

There are four habitats/ vegetation types through which the proposed new transmission line with go. These include the Karas Dwarf Shrubland, Dwarf Shrub Savanna, Southern Kalahari and Highland Shrubland. The Karas Dwarf Shrubland and Dwarf Shrub Savanna vegetation types are characterized by shallow, stony soils that carry a predominance of grasses and Karoo shrubs. Sizeable woody species are largely confined to drainage lines within this vegetation type and the verges of seasonally wet depressions and pans. The range of the habitats' availability in Namibia is considered large, 66,087 km^2 for Karas Dwarf Shrubland and 65,794 km^2 for the Dwarf Shrub Savanna, respectively. *Aloe dichotoma* (Kokerboom, Quiver tree) (VU) occurs within these vegetation types, however, is not likely to be directly impacted by the project and should be avoided as far as reasonably practical. An area within the Dwarf Shrub Savanna, with a high density of *Vachellia erioloba* (camelthorn, new name *Vachellia erioloba*) trees, a nationally protected species, has been identified, north of Mariental town, and will likely be directly impacted by the project. The species is not of particular conservation

[1] https://www.worldbank.org/en/ projects-operations/environmental-and-social-framework/brief/environmental-and-social-standards#ess6

concern; however, the highlighted area should be marked as sensitive and additional mitigation measures need to be implemented to minimize impacts on this tree species. The project activities are linear in nature, and the areas which will be traversed by the proposed new 400 kV transmission line are considered to be largely natural not substantially modified in terms of the area's primary ecological functions and species composition. The impact of this project on the vegetation types is likely to be very low, especially over the medium to long term, provided that the recommended mitigation measures are adhered to in order to conserve protected tree species and to minimize unnecessary habitat loss along the route. However, the Karas Dwarf Shrubland and Dwarf Shrub Savanna habitats are considered important for the Ludwig's Bustard, in particular in the "hotspot" areas (see below).

Avifauna

The study area supports a relatively high diversity of birds with several Red Data species of Critically Endangered (CR) and Endangered (EN) conservation concern occurring within the greater CHAA. These include the White-backed Vulture (CR), Lappet-faced Vulture (EN), Black Harrier (EN), Martial Eagle (EN), Secretarybird (EN) and Ludwig's Bustard (EN). The latter species is considered to be particularly vulnerable to power line collisions.

- Key bird species of particular concern, which are considered to meet the requirements as stipulated in ESS6 for Critical Habitat, in addition to those that should be regarded as sensitive from a conservation point of view, are highlighted and discussed below. **Ludwig's Bustard** is classified as Globally Endangered, according to the IUCN Red Data list of species. It is also listed as Endangered on the Namibian Red List. It is found predominately in western Namibia (Scott *et al*. 2015[2] and references therein) and in much of western and south-central South Africa and extends into the extreme south-west of Angola and the Southern tip of Botswana (Scott *et al*. 2015)[2]. It is considered near-endemic to southern Africa. This species prefers open grassland areas such as those found in the Karas Dwarf Shrubland and Dwarf Shrub Savanna. Relatively high frequencies of power line collisions for bustards have been reported in Namibia, and in all four habitats in study area, in particular, the recorded collision data indicates a high incidence of Ludwig Bustard collisions, predominantly in the south of the line near Keetmanshoop (Kokerboom Substation), in addition to Mariental and Kalkrand. The habitats in these areas are therefore considered to be important to Ludwig's Bustard and as such are considered as Critical Habitat areas.
- **Kori Bustard:** this species is rated as Near Threatened on both a Global and national scale (in Namibia). This bustard species does not meet the requirements for an area to be considered critical habitat. However, the populations of these species are considered to be vulnerable due to the recorded high collision rates with power lines. It favors the same habitats as the Ludwig's Bustard and would therefore benefit from the conservation efforts implemented to reduce impacts on the Ludwig's Bustard populations in Namibia.
- **Secretarybird:** this species is rated Globally Endangered (IUCN) and Vulnerable on the Namibia Red List of species. The requirements of ESS 6 are not triggered for this species due to the relatively wider distribution of this species throughout Africa. However, the large areas of open, sparse grassland habitat in the study area are likely to be important for this species, although not considered as Critical Habitat, but should be viewed as sensitive from a conservation point of view.
- **Verreaux's Eagle**: this species is rated as Least Concern on the IUCN list of Red Data species and therefore does not trigger the requirements under ESS6. However, the planned power line will pass through a narrow mountain pass 1.1 km from two nests of Verreaux's Eagle (and within the 10 km buffer identified in the EIA); although this section cannot be re-routed, it is recommended that it is marked as a mitigation, with ongoing monitoring.

[2] http://www.the-eis.com/atlas/sites/default/files/Ludwig%27s_Bustard.pdf

Even though these vegetation types are assessed as being important habitats for Ludwig's Bustard, and other mentioned species, the range of the habitats' availability in Namibia is considered relatively large. The impact of the proposed transmission line on the integrity of the habitat, per se, is considered to be site-specific, and minimal (limited habitat loss/destruction), and it therefore poses a very low threat to the overall population of the bustard species. It is rather the presence of the power line as a physical barrier in the habitat, which poses the threat in terms of potential collisions, that needs to be addressed more intentionally.

Biodiversity risks/potential impacts

The transmission line route is linear and the direct belt of vegetation to be removed is small in comparison to the wider habitats of similar vegetation. The following risks and impacts in terms of habitat and vegetation have been identified, namely direct destruction of, or damage to, nationally protected and/or endemic plant species, namely the *Vachellia erioloba* in particular; and illegal collection of plant material such as wood or pods during construction. Potential impacts and risks have been taken into consideration as part of the route selection; in addition, the route has also been optimized to avoid habitat fragmentation and destruction, as far as reasonably possible.

The four main potential impacts on avifauna, associated with the construction of the new 400 kV transmission line, are 1) physical disturbance of birds; 2) habitat destruction/modification during construction (including road mortality/poaching of birds); 3) bird collision with power line structures during the operational phase; and 4) bird electrocution by power line structures during the operational phase. These impacts are considered to be negative, with various significance. However, the impacts can be mitigated to an acceptable level.

Comparison of route alternatives

Two route alternatives were considered: a western route which follows the corridor of the existing 400 kV transmission line and an eastern (preferred) route which follows the corridor of an existing 220 kV line for the majority of the way before splitting off near Tsumis, approximately 40 km south of Rehoboth.

A comparison of the two power line route alternatives indicates little difference in terms of impacts on avifauna and vegetation. However, the western route (448 km) is overall 13 km (3%) shorter than the eastern route (461 km), and therefore potentially of a slightly lower impact (with less avifauna and vegetation habitat). The section of power line running through the open, sparse grassland habitats (preferred by bustards) in the south is 20 km (6%) longer in the case of the eastern route, compared to the western route. In balance, however, current results obtained from monitoring data of the existing 220 kV and 400 kV transmission lines indicate that bird collisions are taking place along most sections of both power lines.

In terms of the risk to White-backed Vulture, the eastern route is preferable to the western route, as it is further from the sensitive areas. The Verreaux's Eagle breeding area is potentially impacted on both route alternatives; however, mitigation is recommended.

The eastern alternative is closer (10 km) to the Hardap Nature Reserve, which is classed as an Important Bird Area (including Hardap Game Park and Hardap Dam), with a possible high risk for waterbird collisions. The cumulative impact between the two alternatives in the Hardap Dam area is therefore likely to be relatively lower in the case of the western line, as it is further away from the dam. However, the ephemeral Fish River and its associated aquatic habitats to the south, on the western route, should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds.

From an electricity supply point of view, the eastern alternative corridor alignment presents fewer technical constraints. The western alternative is considered to be technically unfeasible due to the need for the line route to cross the existing 220 kV line in two locations, which would need the installation of costly towers to ensure safe clearance, while the close proximity of the two 400 kV lines increases the risk of a natural event causing a failure (power outages) of both lines. Further details in this regard are provided in the main ESIA document.

Mitigation and management

Biodiversity Risk Management (or mitigation) measures following a mitigation hierarchy approach.

This approach guides appropriate actions to achieve No Net Loss (NNL) of biodiversity, or preferably Net Gain (NG). Actions should be implemented in the following order of priority: 1) avoidance, 2) minimisation, 3) rehabilitation/restoration and 4) offset. To achieve NNL, all predicted negative biodiversity impacts need to be accounted for, whereas, to achieve Net Gain, offsetting needs to bring an overall positive impact on biodiversity.

The habitats will fall within the area to be mitigated by the recommended staggering or offsetting of 400 kV and 220 kV power line pylons (i.e. with the lines running in parallel, apart from the final 122 km), together with adaptive management in the form of retro-fitting of markers in problem areas on both the existing and new transmission lines, as recommended by the avifauna specialist.

A staggered design (i.e. the "staggering" or offsetting of pylons of the new 400 kV line with those of the adjacent 220 kV line) is being proposed, to increase the visibility of the obstruction of the power line infrastructure to flying birds, and thus reduce the chances of collisions.

This mitigation is considered a potential solution, to reduce bird collisions, in particular for the bustard species, and as such it is anticipated that the number of bird deaths at a regional scale can be significantly reduced. It should, however, be noted that this approach has not yet been proven, and will be applied as a trial to determine the effectiveness of staggering transmission lines to reduce bird collisions. It is proposed that, prior to construction, further studies, in addition to consultations with avifauna specialists, be conducted to refine this approach as a mitigation measure as part of the finalization of the design, in addition to refining the power line marking methods to be used, prior to construction and as part of the preparation of a robust monitoring plan in the BMP.

The BMP will set out a short (pre-construction), medium (during construction) and long term (post-construction) monitoring programme. The BMP will in particular focus on the monitoring of key critical habitat areas, to assess the effectiveness of the mitigation measures that have been proposed thus far (staggering and line markers), with an aim to achieve Net Gain. A further aim of the monitoring is to assess local population numbers and trends of sensitive bird species (especially bustards) that are using these key critical habitat areas.

The BMP will contain the requirements for further, ongoing biodiversity monitoring during the operational phase, to evaluate how effectively the mitigation measures proposed are in achieving the Net Gain targets.

Plan of Study to obtain additional data

There is a need for up-to-date local population estimates, particularly for Ludwig's Bustard, Kori Bustard and Secretary bird, to guide mitigation and management interventions on a local level. Given that the above (bustard) species are nomadic in response to rainfall and its effects on their habitats and foraging, such monitoring should be done to obtain representative data for at least one dry and one wet season.

A competent ornithologist familiar with power line work will be engaged to prepare a detailed study plan based on available data and knowledge of the area. The specialist will pay particular attention to ensure a robust plan for obtaining additional data in the "hotspot" areas identified in this CHA; this includes the southern area of the line near the Kokerboom Substation, near the town of Mariental and just north of Kalkrand. The objective of the study should be to obtain additional information on the local population sizes of the key species (Ludwig Bustard and Kori Bustard) within these key hotspot areas in the CHA area. The additional information will then be used to verify the likelihood and significance of the impacts associated with the proposed project on the key birds and critical habitats. It will further refine the robustness of the proposed mitigation measures (staggering of the line, in combination with markers in specified areas) and propose a robust long term monitoring program to be implemented as part of the BMP to be prepared for this project.

In an effort to ensure the proposed mitigations and long-term monitoring program to be recommended in the BMP are robust, the specialist/NamPower will further engage with experienced ornithologists, with particular knowledge of the key species (Ludwig's Bustard) and impacts on this species as a result of transmission line projects. Specialists or organizations to consider for consultation may include, among others, the Namibia Nature Foundation, Percy FitzPatrick institute, BirdLife SA, Endangered Wildlife Trust etc. in addition to other conservation organizations in Namibia, and specialists with keen interest and experience with wildlife-transmission line interactions.

Conclusion

The Karas Dwarf Shrubland and Dwarf Shrub Savanna vegetation types are considered to be important habitat for Ludwig’s Bustard, with particular areas of interest having been identified based on recorded collision data. This includes the areas near the Kokerboom Substation in the south of the proposed line, the areas near Mariental town and areas just north of Kalkrand. Due to the classification of this species as Globally Endangered based on the IUCN Red List, and taking into account the criteria for Critical Habitat as stipulated in paragraph 23 of the World Bank Environmental and Social Standard 6, these areas could be considered as important to this Endangered species and therefore considered as Critical Habitat.

It must be reiterated that the impact of the proposed transmission line on the integrity of the habitat *per se* is considered to be site-specific and minimal (limited habitat loss/destruction), and therefore poses very low threat to the overall population of the species. It is rather the presence of the power line as a physical barrier in the habitat, which poses the threat in terms of potential collisions, that needs to be addressed more intentionally.

NamPower will, therefore, need to manage the identified risks and impacts in accordance with the mitigation hierarchy and Good International Industry Practice (GIIP). It will adopt a precautionary approach and apply adaptive management practices in which the implementation of mitigation and management measures are responsive to changing conditions and the results of robust ongoing project monitoring. Additional field studies to obtain the estimated population size, and to verify identified hotspot areas and the sizes of their smaller local populations will be required, in addition to further consultations with species' experts on the feasibility and robustness of the mitigation measures that have been proposed to date. The Biodiversity Management Plan that will need to be prepared for this project will therefore need to contain a robust, short (pre-construction), medium (construction) and long term (post-construction) monitoring programme to assess the effectiveness of the mitigation measures that have been proposed thus far (staggering and line markers), with an aim to achieve Net Gain.

In an additional effort to reduce the impact of power lines on the Ludwig's Bustard, the project proposes to support a second phase to the NamPower Namibia Nature Foundation Strategic

Partnership, which previously did studies on interactions between the electricity supply and wildlife in an effort to provide management measures to consider for the electricity supply network to reduce its impacts. The ongoing support will assist in obtaining information for the electricity network in Namibia (current and planned), with a specific objective to identify biodiversity hotspots, in particular for the key bird species, to assist with implementation of retroactive mitigation measures of existing lines, where feasible, and planning of future power lines, which need to avoid these areas as far as reasonably possible.

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Abbreviations, acronyms and glossary of terms

AoI	Area of Influence
BFD	Bird Flight Diverter
BMP	Biodiversity Management Plan
CHA	Critical Habitat Assessment
CHAA	Critical Habitat Area of Analysis
CIA	Cumulative Impact Assessment
DEA	Department of Environment Affairs
ECC	Environmental Clearance Certificate
EIA	Environmental Impact Assessment
EIS	Environmental Information Service
EMA	Environmental Management Act
EMP	Environmental Management Plan
Endemic	Occurring within a restricted range Endemic status categories: E = endemic, NE = near-endemic, sAfr = southern Africa, Nam = Namibia
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESS	Environmental and Social Standard
GIIP	Good International Industry Practice
GN	Guidance notes for ESS6 (World Bank 2018)
IBA	Important Bird Area
IFC	International Finance Corporation, a member of the World Bank Group
IUCN	International Union for the Conservation of Nature IUCN Red List Categories: LC Least Concern NT Near Threatened VU Vulnerable EN Endangered CR Critically Endangered EW Extinct in the Wild EX Extinct G Global status
kV	kilovolt
MEFT	Ministry of Environment, Forestry and Tourism
NAD	Namibian Avifaunal Database
OPGW	Optical ground wire; a wire that includes communication functions provided by the incorporated optical fibers in addition to the existing overhead ground (earth) wire, which protects the transmission cables from lightning strikes and secures current flow in case of cable fault (https://www.lscns.com)
QDS	quarter degree square
Residency	R = resident, N = nomadic, M = migrant, V = vagrant; Ra = rare
SABAP	Southern African Bird Atlas Project (SABAP1 & SABAP2)
S/S	Substation

Consultants' declaration of independence

Dr Ann Scott and Mike Scott of African Conservation Services cc are independent consultants subcontracted by Enviro Dynamics Environmental Management Consultants. We are registered Ordinary Member Practitioners with the Environmental Assessment Practitioners Association of Namibia (EAPAN; https://eapan.org/) and uphold its Code of Conduct. We have no business, financial, personal or other interest in the activity, application or appeal in respect of which we were appointed, other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise our objectivity as a specialist in performing such work.

Dr HA Scott RM Scott

16 November 2023

1 Introduction

1.1 Project background

The national power utility of Namibia, NamPower intends to construct a 400 kV power line from the Kokerboom Substation, near Keetmanshoop in the south of Namibia, to the Auas Substation, about 40 km from Windhoek in the north (Figure 1). The line will cover 461 km.

The purpose of the construction of the new 400 kV Auas to Kokerboom transmission line is to strengthen the overall transmission network in Namibia. Without upgrades to the transmission line network, future electricity supply in Namibia will become constrained and, as a result, restrict development (mining, industrial and residential) and negatively impact quality of life in the country as a whole. Also, the number of cases where an outage of the existing 400 kV line can be accommodated (hence relying only on the 220 kV interconnector from South Africa) is becoming less and less each year as the Namibian electricity load grows.

Two existing transmission lines, a 400 kV and a 220 kV line, connect the Kokerboom and Auas substations, but this infrastructure alone is considered inadequate to meet the future power demands of the country. Therefore, NamPower has approached the World Bank to support the construction of a new 400 kV line between the above two substations.

Two proposed route alternatives for the new 400 kV line were considered. The preferred (eastern) route, shown in Figure 1, follows the existing 220 kV line to the east, while the alternative (western) route mostly follows the existing 400 kV line to the west.

An Environment Impact Assessment (EIA) was prepared in 2020 (Enviro Dynamics 2020), to meet the requirements of the Namibian environmental legislation. The EIA included a full avifauna assessment (Simmons 2018), with a subsequent review (African Conservation Services 2019) and amendment to the assessment (Simmons 2020), together with vegetation studies.

An Environmental Clearance Certificate (ECC) was obtained from the Ministry of Environment, Forestry and Tourism (MEFT) on 29 January 2021 and is valid until 29 January 2024. A Project Area of Influence (AoI) of 500 m either side of the transmission line was used in the 2020 EIA to assess direct and indirect impacts associated with the transmission line, while a much broader bandwidth of approximately 60 to 100km, either side of the planned and alternative power line, was considered, taking into account the distribution of the bird species over a wider area, in order to gain an understanding of the relative importance/uniqueness of the area on a regional (or even global) scale, rather than focusing only on the narrow project site itself.

In the light of what can be concluded regarding the potential impacts associated with the proposed transmission line, the EIA (Enviro Dynamics 2020) considered that NamPower will be able to reduce the significance of most of the impacts to acceptable levels, if it implements the mitigation measures outlined in both the Construction and Operational ESMP (which take into account the above amendment). It is therefore important that the EMP is audited to ensure compliance and that monitoring takes place as outlined therein, otherwise the impacts identified will remain unacceptable.

NamPower has submitted a request to the World Bank to fund the construction of the new Auas - Kokerboom 400 kV Transmission Line. The 2020 EIA study is therefore being updated to meet the requirements of the World Bank Environmental and Social Framework (ESF; World Bank 2016). As part of the updating of the EIA, a Critical Habitat Assessment, in accordance with ESS 6, was initiated to assess the presence of any critical habitats that may be significantly negatively impacted by the proposed new 400 kV transmission line.

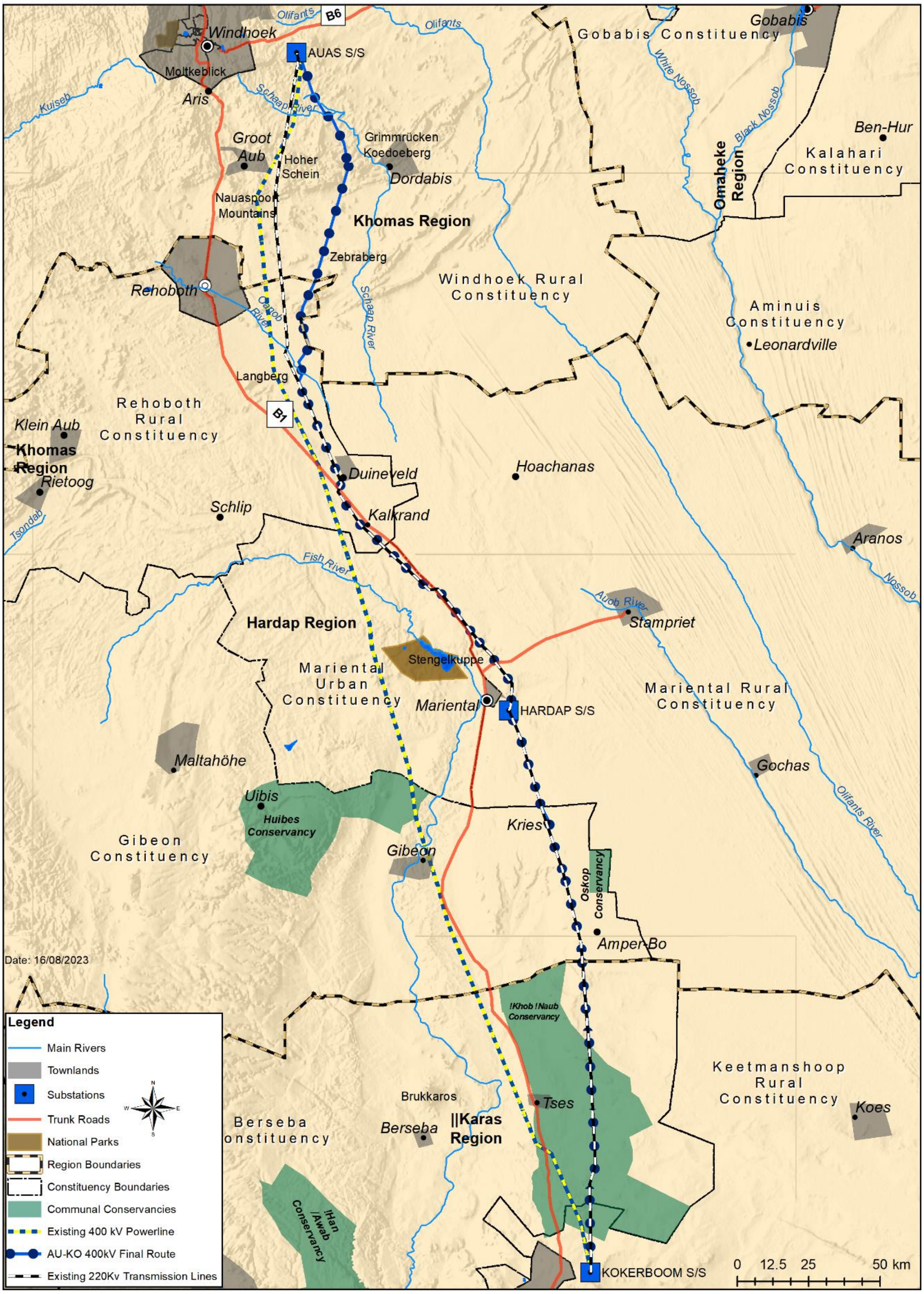

Figure 1: Locality of the proposed 400 kV transmission line.

1.2 Technical details of the new 400 kV transmission line

The structure of the new 400 kV power line will be a V-type guyed (cross rope) suspension tower (Table 1, Figure 2). The tower height is between 28.5 m to 43.5 m, with the average tower typically being approximately 37.5 m, and a span length of approximately 550 m. A single optical ground wire (OPGW) will be suspended from the top of each side of the tower.

Table 1. Comparative components of the planned 400 kV line structure that will run largely in parallel with the existing 220 kV line structure.

Line	Structures	Tower height (m)	Span length (m)
Planned 400 kV	• V-type guyed (cross rope) suspension tower (90% of the line) • Self-supporting strain structures	28.5 m to 43.5 m, most commonly 37.5 m	Approx. 450-550 m
Existing 220 kV	• Self-supporting, double circuit lattice pylon (suspension and strain structures)	32 m to 40 m, most commonly 34.5 m	Approx. 450 m
Existing 400 kV	• V-type guyed (cross rope) suspension tower (90% of the line) • Self-supporting strain structures	28.5 m to 43.5 m, most commonly 37.5 m	Approx 450-550m

For the preferred route, the planned 400 kV line will run largely in parallel with the existing 220 kV Kokerboom - Hardap and Hardap - Auas 1 lines (apart from the final 122 km in the north). The servitude will be 80 m wide (40 m each side of the centre line) for the entire line. A service road of approximately 12 m width will be cleared of vegetation and obstacles, within the allocated 80 m wide servitude. The access road will be utilized during construction, as well as during the maintenance phase throughout the 30-year lifespan of the transmission line. Since the line will run parallel to the existing 220 kV power line, to the south, the combined servitude width of the existing and new line will be 110 m in total. The 110 m servitude consists of a minimum distance of 46 m between the two lines, and a 40 m servitude outside the center line of the 400 kV line, and 25 m outside the centre line of the existing 220 kV line. The area from the centre of each tower structure to be cleared of vegetation will be approximately 70 m X 50 m. However, the ESIA assessed a corridor of 500 m wide (250 m on either side of the proposed line) and a wider range (see Section 2.4 below) for the bird and Critical Habitat Assessment.

Figure 2. The structure of the pylons for the planned 400 kV power line, showing the V-type guyed (cross rope) suspension tower (used for 90% of the line) (left), and the self-supporting strain structure (inset); and the self-supporting pylon of the existing 220 kV power line (right); the structure for the 220 kV strain towers is similar.

2 Aims and approach to the Critical Habitat Assessment

2.1 Terms of Reference

According to the Terms of Reference (ToR; NamPower 2023), the objective of the overall ESIA consultancy is to update the EIA report that was undertaken by Enviro Dynamics (2020) for the proposed project, along with all relevant associated environmental instruments as set out in the above ToR (see Appendix 1 for outline and details of the legal framework).

The updated ESIA report needs to comply with and meet the legal and technical requirements of Namibia and the World Bank ESF. This includes meeting the World Bank requirements, amongst others, of ESS6 in the case of this study, the World Bank Group's (WBG) Environmental Health and Safety (EHS) Guidelines, and WBG EHS Guidelines (EHSG) for Electric Power Transmission and Distribution (also see Section 2.3 below).

All beneficial and adverse impacts associated with the construction and operation of the project, including all associated/ancillary works and linked activities, if any, need to be assessed and taken into account.

2.2 Aim of the Critical Habitat Assessment

The Critical Habitat Assessment (CHA) is the outcome of the present Biodiversity Report and feeds into the above ESIA report and a Biodiversity Management Plan that is currently under preparation.

The assessment is based on a review and assessment of available biodiversity baseline data based on previous studies conducted as part of the 2020 EIA, available desktop information, including bird collision data for the transmission corridor. The information obtained during the preparation of the previous EIA is still considered relevant and the specialist is of opinion that additional field studies at this stage will not result in significantly different results. It is, however, intended that additional field data will be obtained prior to construction to supplement the findings of this report further. Post-construction monitoring will continue for this project once the line is operational. The report delineates the habitats (Critical Habitats, Natural Habitats and Modified Habitats) along the transmission line corridor, in compliance with World Bank ESS6 on Biodiversity Conservation.

Note that scientific names of bird species are included in Appendix 2.

2.3 Screening/identification of area of analysis

The area directly impacted by the proposed new 400 kV transmission line is strictly linear, running for 461 km from south to north across southern Namibia (Figure 1, 3, 4). Apart from the final 122 km, the servitude follows the route of an existing 220 kV power line, which already resulted in some modification of the habitats. As previously mentioned, the combined servitude width (new 400 kV and existing 220 kV) will be approximately 110 m wide.

To identify and assess the areas of Critical Habitat along the transmission corridor, a Critical Habitat Area of Analysis (CHAA) needs to be defined. For the present assessment, a CHAA of 60-100 km on either side of the planned and alternative power line servitudes is indicated, arbitrarily, as a broad, focal CHAA (Figure 4). The consideration of the distribution of the bird species over a wider area enables the study to gain an understanding of the relative importance/uniqueness of the area on a regional (or even global) scale, rather than focusing only on the narrow project site itself.

The potential geographical distribution of the Red Data bird species concerned (including raptors, and bustards) is also mainly relatively large, and bird movements take place over considerable areas although, within such areas, the distribution may be patchy. The distribution of (Namibian) near-endemic species is relatively more restricted.

Within the CHAA, specific potentially sensitive areas/features with a higher biodiversity value, that allow for a more well-defined habitat demarcation, have been considered. Areas of potential sensitivity include breeding sites/areas for White-backed Vulture and Verreaux's Eagle, wetland habitats including the Hardap Nature Reserve Important Bird Area (IBA) with the Hardap Dam and its associated irrigated areas, and the ephemeral Fish River catchment [see Figure 4 below]).

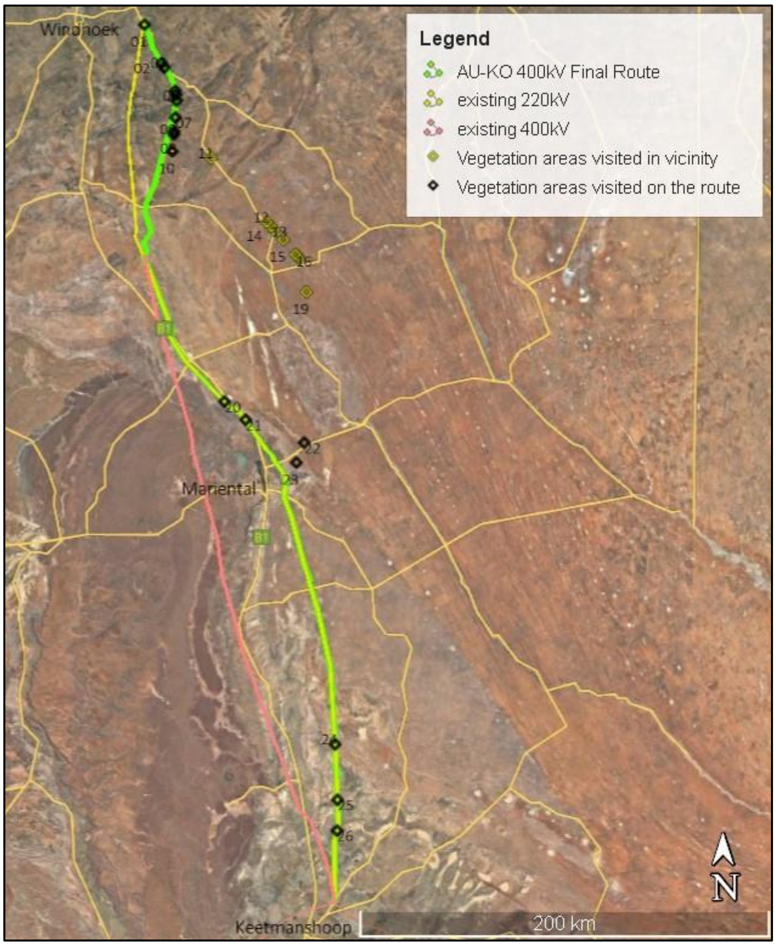

Figure 3. Locality of vegetation survey sites for vegetation assessment.

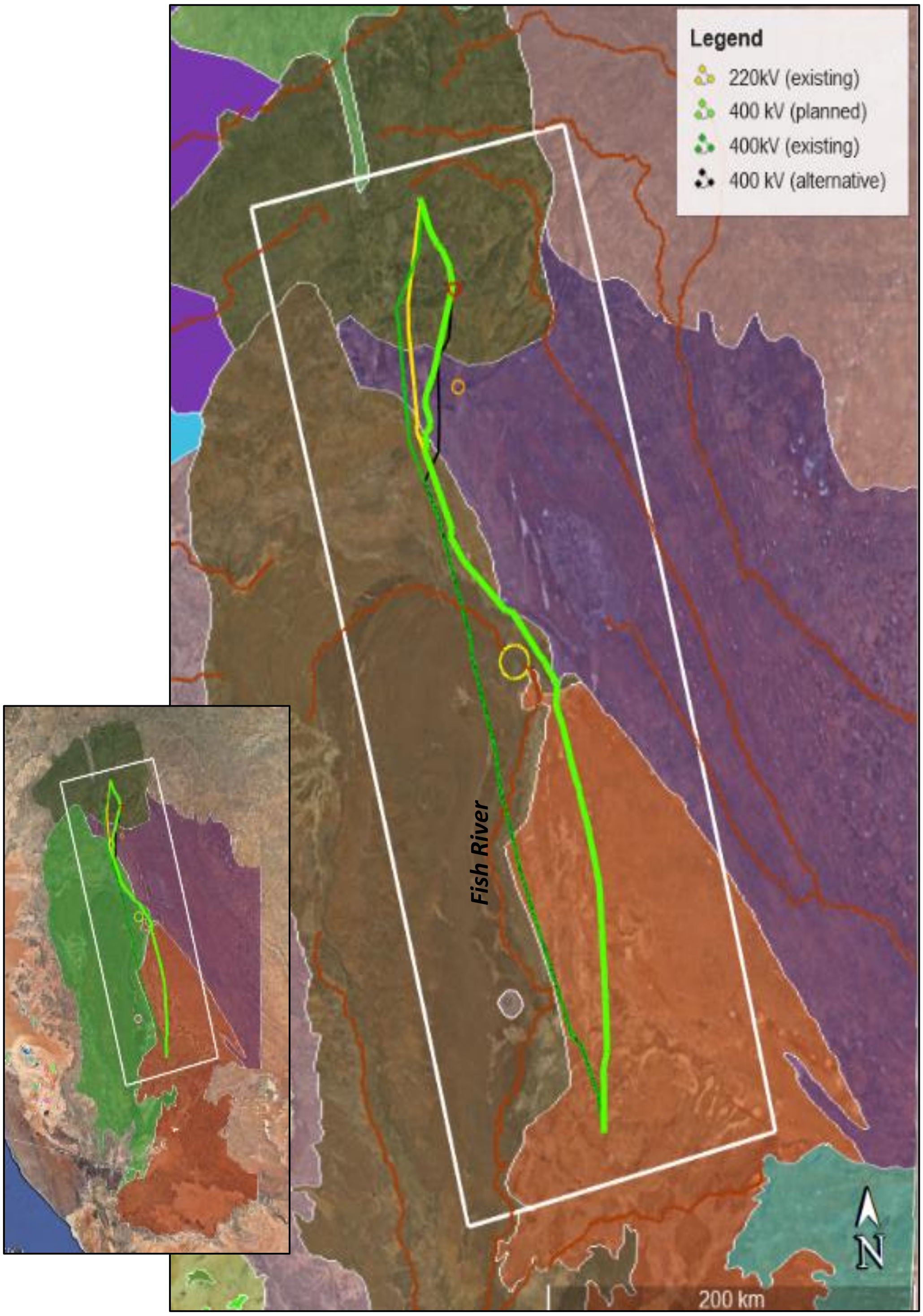

Figure 4. Detail of focal study area or Critical Habitat Area of Analysis (CHAA) as indicated, arbitrarily, on average around 60-100 km from either side of the planned and alternative power line servitudes (white polygon); vegetation types/habitats through which the two routes run are also indicated (red-brown = Karas Dwarf Shrubland; dark brown = Dwarf Shrub Savanna; purple = Southern Kalahari; dark green = Highland Shrubland; inset shows extent of each vegetation type, in Namibia), as well as potentially sensitive avifauna habitats/features (orange circle = White-backed Vulture breeding area; red circle = Verreaux's Eagle breeding area; yellow circle = Hardap Nature Reserve IBA; brown lines = ephemeral rivers) (based on a Google Earth image; EIS 2023).

2.4 Assumptions and limitations

Vegetation

The original specialist vegetation study (Mannheimer 2016) was mainly a desktop study. It was based on prior knowledge of the zones and records from the National Botanical Research Institute of Namibia. For this study the above vegetation types were considered in their broader sense, supported by (limited) fieldwork to ground truth the occurrence of vegetation species on the route with a 500 m buffer on either side of the centre point of the proposed transmission route (see Section 2.4, Figure 3 above). The study was updated using additional information obtained from desktop studies. The above was judged to be sufficient information for this linear impact, which avoids the sensitive high slopes of the Highland Savanna.

Avifauna

Assumptions

- Combined SABAP1 and SABAP2 and other data used in this report provide a representative indication of the bird species likely to occur in the CHAA throughout the seasonal and inter-annual cycles.

Limitations and information gaps

- The criteria for the Critical Habitat Assessment (CHA) take into account both global and local population estimates. Global estimates for most species are provided on the IUCN website (IUCN 2023); however, for some species no estimates are available (e.g. Kori Bustard; and Namibian near-endemic species), or estimates are considered to be dated. Local population estimates for the CHAA itself are not available. The best available data are used; and any gaps are indicated in the analysis by species. The above limitations could affect the robustness of the CHA; a confidence level is therefore provided. In the final analysis, the bird species assessed are grouped into (1) species with high-medium confidence in the assessment; and (2) those where the confidence in the assessment is lower. Species that are likely to be impacted are highlighted in the final assessment. Recommendations are made for further field work over the longer term, to supplement the above local estimates. Given the above uncertainties, the precautionary principle was therefore applied, with the application of adaptive management practices in which the implementation of mitigation and management measures are responsive to changing conditions and the results of ongoing project monitoring.

3 Habitats

The World Bank ESS6 categorizes habitats as either "modified habitat", "natural habitat" or "critical habitat", along with "legally protected and internationally and regionally recognized areas of biodiversity value", which may encompass habitat in any or all of these categories. The definitions of each of the habitats according to the ESS6 are presented below:

- **Modified habitats** are defined as areas that may contain a large proportion of plant and/or animal species of nonnative origin, and/or where human activity has substantially modified an area's primary ecological functions and species composition. Modified habitats may include, for example, areas managed for agriculture, forest plantations, reclaimed coastal zones and reclaimed wetlands.
- **Natural habitats** are areas "composed of viable assemblages of plant and/or animal species of largely native origin, and/or where human activity has not essentially modified an area's primary ecological functions and species composition."
- **Critical Habitats** are defined as areas with high biodiversity importance or value, including:
    a. habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches;
    b. habitat of significant importance to endemic or restricted-range species;
    c. habitat supporting globally or nationally significant concentrations of migratory or congregatory species;
    d. highly threatened or unique ecosystems;
    e. ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d) .

Although the construction of existing infrastructure, including the existing 220 kV power lines and roads, has to some extent changed to the natural habitat, the habitats are not considered as falling into the category of "modified habitat" as described in ESS6, since the habitats in the surrounding areas are still largely intact. Human activity has not substantially modified the area's primary ecological functions and species composition (ESF Guidance Note 19).

Most of the habitats which will be traversed by the proposed new 400 kV transmission line corridor, are considered to fall within the classification of "natural habitat" as described in ESS6, as it is home to plant and animal species mainly of native/indigenous/non-alien origin. The primary ecological function and species composition of these habitats are considered to be largely unchanged. Human activities in these habitats are centered around livestock grazing (sheep and goats), which has taken place over a long period of time. The character and functions of the habitat are considered to remain essentially natural (ESF Guidance Note 19.1).

Additional habitat loss, habitat degradation and habitat fragmentation associated with the installation of the planned new 400 kV line will be minimized by closely following the existing 220 kV transmission line servitude. Due to the linear nature of the project, impacts on habitats are considered to be limited, while impacts on fauna species in the CHAA are considered minor, with the exception of key avifauna species of conservation concern that rely on these habitats and will largely be impacted during the operational phase of the transmission line.

No specific habitats that support specific fauna species of conservation concern will be affected by the proposed transmission line project.

Areas of conservation value

Legally protected and internationally and regionally recognized areas of biodiversity value in the greater CHAA include the Hardap Game Park (Hardap Recreational Area), a protected area (National Park) in terms of Namibian legislation. It is, however, designated as such, for recreational purposes, but not considered sensitive from a biodiversity point of view, besides from an avifauna perspective (discussed in the avifauna section below). The land is not directly traversed by the transmission line, but skirted by approximately 10 km, if the eastern route is followed, and further (20 km) if the western route is followed.

The **!Khob !Naub Conservancy** (Figure 1), to the south of the CHAA , has wildlife populations for which hunting permits are issued by the Ministry of Environment, Forestry and Tourism, administered by its appointed conservancy committee. This serves as an income for the local population. Conversations with the committee members have indicated that the transmission line will not be a threat to these wildlife populations since it is aligned 1) adjacent to the existing 220 kV transmission line, away from the more remote areas where hunting is carried out; and 2) habitat modification will be very limited, and grazing can continue once the line is operational. Furthermore, the wildlife occurring there is widespread and not considered to be of any conservation value in terms of the IUCN status. Therefore, this conservancy does not trigger any of the ESS6 requirements.

4 Vegetation

4.1 Introduction

A vegetation specialist study was carried out as part of the original EIA (Enviro Dynamics 2020

The proposed 400 kV transmission line passes through four vegetation types (vegetation habitats), according to the vegetation classification of Geiss (1998), which are further discussed in the sections below. The vegetation types have a relatively large range across Namibia, as follows:

- Karas Dwarf Shrubland: 66,087 km^2
- Dwarf Shrub Savanna: 65,794 km^2
- Southern Kalahari: 57,901 km^2
- Highland Shrubland: 23,806 km^2

For the CHA, these vegetation types have been considered in their broader sense (see Figure 5), although actual fieldwork to ground-truth the occurrence of vegetation species on the route was done using a 500 m buffer either side of the centre point of the proposed transmission line route, as previously mentioned. Selected sites were identified based on the occurrence of vegetation of potential conservation concern and surveyed as part of the field study. Field survey work undertaken, outside the demarcated 500 m buffer, was used to contribute to the understanding of the vegetation types and habitats within the CHAA.

As mentioned in Section 3, because of the linear nature of the project, potential impacts on habitats (vegetation units) are considered to be minimal. The estimated percentage of the vegetation units that will be impacted, should the corridor be cleared of vegetation (worst case scenario) are presented in the table below. The estimated sizes have been calculated using the average width (80 m) of the 400 kV servitude, and length of the new line that passes through each of the above-mentioned vegetation types.

Table 0-1. Estimated impact per vegetation unit affected by the proposed transmission line.

Vegetation type	Extent (in Namibia) (km^2)	Planned route (eastern, in km)	Estimate of the vegetation unit affected (km2 and %)	Alternative route (western in km)	Estimate of the vegetation unit affected (km2 and %)
Karas dwarf shrubland	66,087	205	16,4 (0,024%)	144	11,52 (0,017%)
Dwarf shrub savanna	65,794	141	11,28 (0,017%)	183	14,64 (0,022%)
Southern Kalahari	57,901	41	3,28 (0,005%)	46	3,68 (0,006%)
Highland shrubland	23,806	75	6 (0,025%)	75	6 (0,025%)
TOTAL		**462**		**448**	

The section of the route from the Kokerboom Substation to just north of Mariental forms part of the Nama-Karoo Biome and traverses dwarf shrubland for approximately 300 km, to approximately 15 km north of Kalkrand. The vegetation structure is sparse shrubland on shallow soils, with much gravel, and a low water-holding capacity. This area carries low densities of livestock and wildlife. The northern part of the dwarf shrubland East of Mariental is zoned Dwarf Shrub Savanna in the Atlas of Namibia (Mendelsohn *et al*. 2002; Figure 5), whereas the area south of Mariental towards Keetmanshoop is

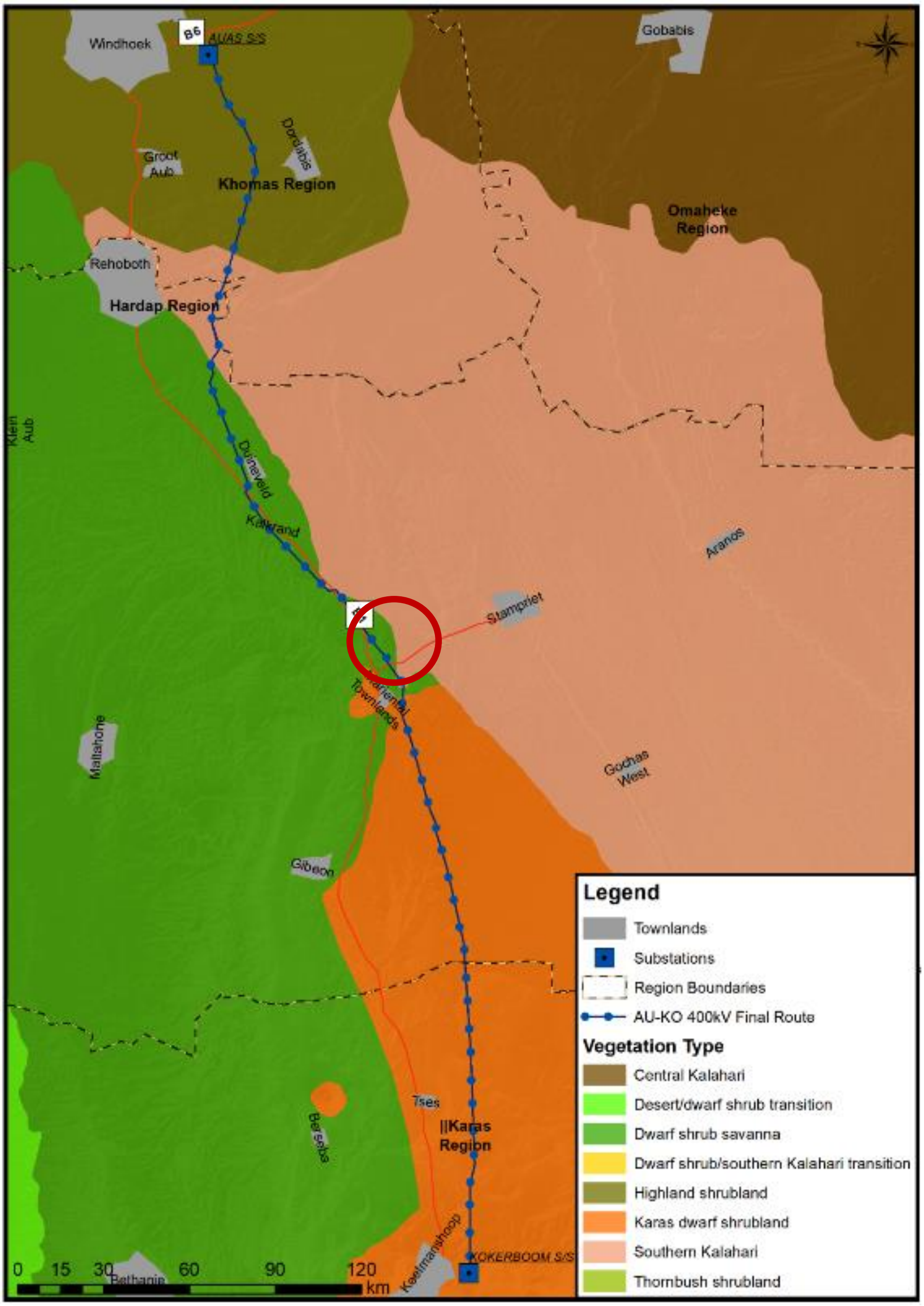

Figure 5. Vegetation zones in the CHAA, with red circle indicating Camelthorn (*Acacia erioloba*) hotspot. Note: position of boundaries and red circle on map are indicative; exact locality of *the Acacia erioloba* hotspot is provided with coordinates in the BMP, and to be confirmed during the pre-construction survey**.**

zoned as Karas Dwarf Shrubland. The above two vegetation types support similar types of plant species, but with the latter having more grasslands interspersed in the shrubland.

From Kalkrand, the route continues through the Mixed Tree and Shrub Savanna of the Southern Kalahari vegetation type for about 90 km, until it reaches the foothills of the Highland Shrubland vegetation type, which it traverses for about 100 km before reaching the Auas Substation.

The list indicating plant species of potential conservation concern on this route is provided in Appendix 2. The list provides both Namibian and Global (IUCN) conservation status for each species.

4.2 Dwarf Shrubland (Dwarf Shrub Savanna and Karas Dwarf Shrubland)

The Dwarf Shrubland zone comprising of the Karas Dwarf Shrubland and Dwarf Shrub Savanna vegetation types which are characterized by shallow, stony soils that carry a predominance of grasses and Karoo shrubs. Sizeable woody species are largely confined to drainage lines within this vegetation type and the verges of seasonally wet depressions and pans. Species of national conservation value which typically occurs within the Dwarf Shrubland zone include Acacia *erioloba (*new name *Vachellia erioloba)* (LC)*, Ziziphus mucronate* (LC)*, Searsia lancea* (LC) and *Euclea pseudebenus* (LC) and woody species such as *Aloe dichotoma* (VU)*, Albizia anthelmintica* (LC)*, Boscia albitrunca* (LC) and *Maerua schinzii* (LC)*.,* These woody species are typically widely scattered within the vegetation types.

Although 18 endemic and 11 Namibian protected species are recorded to occur within the vegetation type, none of these species are considered as of high conservation concern (range or habitat restricted endemic or protected species) are presently known or expected to occur in any meaningful numbers along the route in this vegetation zone. Those species that are listed on the IUCN Red List are all considered to be of low risk, with a conservation status of "Least Concern" (LC), with the exception of *Aloe dichotoma* which is listed as "vulnerable". Those recorded within the CHAA are all reasonably widespread and very unlikely to be impacted by this proposed project. However, *Aloe dichotoma* (Kokerboom, Quiver tree) (VU) does occasionally form dense stands which should be avoided as far as reasonably possible. The vegetation type is therefore considered to be of **LOW** sensitivity.

4.3 Southern Kalahari with Mixed Tree and Shrub Savanna

This vegetation type is characterized by red sandy dunes generally slanting from north-west to south-east, interspersed with harder inter-dune valleys with stonier, harder substrates. Harder, more compact soils are also characteristic of the riverbanks, and many small pans (often with clay/calcrete substrates) are scattered throughout the zone. Although only one wide-ranging endemic herb is recorded from the vicinity of the route, several nationally protected trees species are common in this vegetation type, including *Vachellia erioloba (Vachellia erioloba), Albizia anthelmintica, Boscia albitrunca* and *Maerua schinzii*. *Ziziphus mucronata* is also typical along rivers and drainage lines. The route east of Tsumis (indicated by red circle on Figure 5) is of particular concern regarding dense stands of *Acacia erioloba*, while dune areas along this section also support large specimens of *Vachellia erioloba* and *Albizia anthelmintica* that are valued by farmers for the shade and the forage they offer to stock animals. These species are, however, listed as being of Least Concern on the IUCN Red List (2022); however, the socio-value of these woodland raises the relative sensitivity of this zone. This vegetation type is therefore considered to be of **MEDIUM** to **HIGH** sensitivity, especially for those areas of dense *Vachellia erioloba* (*Vachellia erioloba*) without mitigation, but can be reduced to **LOW** through the implementation of the necessary mitigation measures proposed.

4.4 Highland Shrubland

The Highland Shrubland is considered as one of the vegetation types with the highest plant diversity and endemism in Namibia. It consists of a mixed tree and shrub savanna that includes many national protected tree species, such as *Vachellia erioloba* (*Vachellia erioloba*), *Aloe littoralis*, *Boscia albitrunca*, *Albizia anthelmintica*, *Maerua schinzii* and *Erythrina decora* as well as those typical of drainage lines, i.e., *Ziziphus mucronata* and *Searsia lancea*. Thirty-six endemic and nine nationally protected species have been recorded within the CHAA around the route.

Species of potential concern include the nationally protected trees and a number of other protected and/or restricted range endemics (e.g. *Anacampseros filamentosa subsp. tomentosa, Aloe viridiflora*). With the exception of *Vachellia erioloba* (*Vachellia erioloba*), which occurs in dense stands over much of this section, and other protected trees that occur as scattered individuals (e.g. *Boscia albitrunca, Albizia anthelmintica*), the non-woody species of highest concern (e.g. *Euphorbia pseudoduseimata, Lopholaena cneorifolia, Ebracteola montis-moltkei*) occur entirely or mostly on high-lying slopes or at the edges of pans, which will either not be affected at all, or will not be affected to any meaningful extent by this project. All these species are listed either as having a low risk and of "Least Concern" according to the IUCN status, or some of the species are not listed as having an IUCN status. This vegetation type is therefore considered as having a **HIGH** sensitivity without mitigation and **LOW** with the application of the necessary mitigation measures.

As previously mentioned, the project activities are linear in nature, and the areas which will be traversed by the proposed new 400 kV transmission line are considered to be largely natural not substantially modifying the area's primary ecological functions and species composition. An area with a high density of *Vachellia erioloba* (camelthorn) trees, a nationally protected species, occurs within the proposed transmission line route (see red circle on Figure 5), and is likely to be directly impacted by the project. Even though this area is not considered critical (the species is "least concern" and widespread in the region, although valued), avoidance and unnecessary removal of these trees is important.

Potential impacts associated with the proposed project and its associated activities, on the vegetation types (habitats) are generally considered to be manageable, low in magnitude over the medium to long term, and can be adequately mitigated through the implementation of mitigation measures following the mitigation hierarchy approached. The project is therefore not considered to lead to any significant adverse impacts on habitats that cannot be mitigated.

5 Avifauna baseline

The CHAA supports a relatively high diversity of birds with several Red Data species of critically endangered (CR) and Endangered (EN) conservation concern occurring within the greater CHAA. These include the White-backed Vulture (CR), Lappet faced Vulture (EN), Black Harrier (EN), Martial Eagle (EN), Secretary bird (EN) and Ludwig Bustard (EN), the latter are considered to be particularly vulnerable to power line collisions (Simmons 2018).

The baseline information for avifaunal habitats and species as contained in the reports below, including the identification of priority species (species at higher risk) are based on information from the previous studies that were conducted, including additional desktop information and consultations with the specialists. The information presented in this report is considered to be adequate to make an informed decision at this stage, and will be further supplemented through additional field monitoring data that will be conducted pre-construction and continue post-construction during the operational phase.

5.1 Brief review of available reports and data

Relevant reports that have been compiled for the project to date are indicated below and were reviewed as part of the preparation of this report. Findings from these reports are highlighted in the subsequent sections. These reports include:

- An avifauna scoping study (Brown 2015), initially conducted on the preferred (eastern) route, which included consultation with all the directly affected farm owners.
- An avifauna specialist study (Simmons 2018), which takes into account the above scoping study, and two route alternatives.
- A review of the above avifauna specialist study and its recommendations (African Conservation Services [ACS] 2019).
- A subsequent amendment to the avifauna assessment (Simmons 2020).
- An EIA for the project (Enviro Dynamics 2020), together with an Environmental Management Plan (EMP), in accordance with which the power line will be constructed and operated, thus satisfying the requirements of the Namibian Environmental Management Act and Regulations (2012).

Updated baseline data that have, subsequently, become available and which have been incorporated in this report include:

- Updates in conservation status (IUCN 2023; https://www.iucnredlist.org/en).
- Southern African Bird Atlas Project (SABAP2) data (https://sabap2.birdmap.africa) – see updated distribution maps for key bird species, Section 4.2 below.
- Power line incident data/records:
  - Updated power line incidents on record for Namibia (www.the-EIS.com); collision rates for bustards on power lines in southern Namibia (Cunningham pers. data 2021, Pallett pers. data/in prep in Silva *et al*. 2023; Scott & Scott 2020 in Silva *et al*. 2023) – see Section 4.3 below.

– Published reports: Shaw *et al*. 2018, 2021; Silva *et al*. 2023 – see Section 8 below.

5.1.1 Key findings of the avifauna scoping study (Brown 2015)

Desktop review

The scoping study subdivided the proposed 400 kV Kokerboom-Auas transmission line into four sections, based on the vegetation types through which it runs (see Figure 1, 4). A full bird species list was compiled for each vegetation type, highlighting species of conservation concern. Recommendations were made for the field work (Simmons 2018, see below), to investigate the potential risks and impacts faced by the above bird species.

5.1.2 Key findings of the avifauna assessment report (Simmons 2018), in terms of impact on birds

Desktop review and field survey

The avifauna assessment report (Simmons 2018) included the findings of the above-mentioned scoping report (Brown 2015) and indicated that the preferred alternative route, from an avifaunal perspective, was to align the proposed 400 kV transmission line as close as possible to the existing 400 kV line (the western alternative).

The report was based partly on a desktop review that includes national long-term bird data collection projects sourced from the Namibian Avifaunal Database (NAD), and field survey. The NAD provide data on the occurrence and relative abundance of all bird species in Namibia, based on quarter degree grid squares, and around the power lines themselves. A list of all bird species that had been recorded in the project area was extracted from the NAD. Each species was then assessed in terms of its Red Data status and whether or not it is endemic to Namibia and to southern Africa. This formed the basis of an assessment of the risk that each species might face as a result of the proposed power line. The current conservation status (both Global and Namibian) of the Red Data bird species is indicated in Appendix 3.

The findings of the above desktop study were verified during the field studies, which were conducted between September 12 to 20, 2017. The field studies sampled 157 km (34%) of the proposed 461 km route and existing power lines. The field visit assessed the proposed route of the power line, paying particular attention to micro-habitat, high-risk collision-prone Red Data species, sensitive and high-risk areas to birds, potential flight path conflict areas, nesting areas and any potential issues that the proposed power transmission may have that may lead to an adverse negative impact on the bird populations.

The survey included both sightings of birds of conservation concern during the field studies, and collection/ observation of avian fatalities associated with the existing power lines within the CHAA of the new proposed Auas - Kokerboom power line. The data from the field observations were augmented with systematic power line fatality data provided by J Pallet (unpublished data), providing confirmation of the rate of fatalities of the priority collision-prone species.

Similarly to the scoping report done by Brown (2015), the proposed 400 kV Kokerboom - Auas transmission line was subdivided into four sections, based on the vegetation types through which the proposed new transmission line will transverse.

Drawing from information contained in the NAD and SABAP1 atlas data, over 200 bird species were recorded from 207 atlasing survey visits to the 19-quarter degree (15' x 15') squares traversed by the proposed 400 kV transmission line from Kokerboom near Keetmanshoop to Auas near Windhoek. The following conclusions (in summary), based on the information on the four vegetation types and their bird data (desktop and field studies), were made:

1. The section of transmission line which stretches from **Kokerboom to near Mariental** traverses the **Karas Dwarf Shrubland of the Nama Karoo biome**. A total of 113 bird species have been recorded, including eight species listed as Threatened or Near Threatened in Namibia's Red Data book (Simmons *et al*. 2015). None of the bird species along this section are considered to be endemic to Namibia although 41 species are considered to be endemic to southern Africa.

2.The section of transmission line between **Mariental to Duineveld,** traverse **through the eastern edge of the Dwarf Shrub Savanna of the Nama Karoo biome**. A total of 200 bird species have been recorded, including 12 species listed as Threatened or Near Threatened in Namibia; one species is considered to be near endemic to Namibia and 63 species are considered endemic to southern Africa.

3. The section of transmission line from **Duineveld to near Rehoboth,** passes **through the western edge of the Southern Kalahari of the Acacia Tree-and-shrub Savanna biome.** A total of 117 bird species have been recorded, including eight species listed as Threatened or Near Threatened in Namibia. None of the bird species along this section are considered to be endemic to Namibia, but 33 species are considered to be endemic to southern Africa.

4. The transmission line section between **Rehoboth to Auas,** passes **through the Highland Shrubland of the Acacia Tree-and-shrub Savanna biome.** A total of 177 bird species have been recorded, including 11 species listed as Threatened or Near Threatened in Namibia; seven species are considered to be near endemic to Namibia and 41 species are considered endemic to southern Africa.

Results of the field survey

The field survey investigated the potential risks and impacts faced by the above bird species from factors such as collision and electrocution, as well as risks posed by birds to the supply of power. The main avian victims of collision were, as expected, the Endangered Ludwig's Bustard and some threatened raptor species.

In summary, the field survey yielded the following results in terms of bustards (both Ludwig's Bustard and Kori Bustard; see Table 2 below):

- ***Fatalities***:
  - 13 fatalities (all bustards) found under 157 km of existing transmission lines:
    - 400 kV lines: 8 fatalities in 102.6 km = 0.08 fatalities/km/year
    - 220 kV lines: 5 fatalities in 55.0 km = 0.09 fatalities/km/year
    - Little fatality difference between lines
- ***Habitat:***
    - Open grassy: 10 fatalities in 62 km of open grassy or mixed open-thornveld = 0.16 fatalities/km/year
    - Thicket or wooded: 3 fatalities in 95.6 km of bush-encroached or thornveld = 0.03 fatalities/km/ year
    - Fatalities in open grassy areas five-fold higher than in thicket

Table 3. All avian power line fatalities and live collision-prone species recorded in similar habitat close to the proposed 400 kV line, 12-20 September 2017 (Simmons 2018). The proposed line (400kV) is differentiated from sections of existing lines (220 kV and 400 kV).

Date 2017	Area and habitat	Line	Distance surveyed (km)	Habitat	Bird carcasses (Species)	Live CPS* (Species)
12-Sep		400	1.4	Thicket farmland	0	
12-Sep		400	3.2	Thicket farmland	0	
12-Sep	Tses	400	18	Thicket	0	
12-Sep		**220**	4.2	Open gravel with grasses	1 (Kori Bustard)	3 (Kori Bustard)
					1 (Bustard species)	2 (PCG)
13-Sep	Mariental	400	20	Thicket + grass	0	8 (PCGx6, Sandgrouse x 2)
13-Sep	Mariental	**220**	17.85	Mixed thornbush + open spaces	2 (Kori Bustard)	1 (Verreaux's Eagle)
					1 (Bustard sp)	
14-Sep	Kalkrand	400	20	Mixed open and thicket	5 (Bustard sp)	2 (B chested Snake-E, WB Vulture)
14-Sep	Kalkrand	**220**	20	Mixed thicket and open	1 (Kori Bustard)	
14-Sep	D1230	**proposed**		Kalahari woodland	N/A	6 (WB Vultures, soaring), 100+ vultures reported breeding
15-Sep	Rehoboth (east)	400	20	Thicket on Kalahari Sands	1 (Bustard)	
						WB Vultures x28 on 66kV
16-Sep	KlipVlei farmland	**proposed**	3.7	Thicket farmland	N/A	3 (Black-chested Snake Eagle)
	KlipVlei farmland	**proposed**	10	Thicket on Klipvlei	N/A	Up to 100 vultures reported on this and surrounding game farms
18-Sep	Khomas Hochland	400	20	Thicket	1 (Ludwig's Bustard)	
18-Sep	Khomas Hochland	220	12.9	Thicket - very dense in places	0	2 (Brown Snake E pair)
20-Sep	Dordabis	**proposed**	20.1	Thicket + riverlines + Poort	N/A	2 (Verreaux's Eagle nests)
	Dordabis	**proposed**	7.3			1 (Augur Buzzard)
	Dordabis	**proposed**	9			

Summary: 13 fatalities (all bustards) found under 157 km of existing transmission lines.
400 kV lines: 8 fatalities in 102.6 km = 0.08 fatalities/km/yr
220 kV lines: 5 fatalities in 55 .0 km = 0.09 fatalities/km/yr (little fatality difference between lines)

Habitat: Open grassy: 10 fatalities in 62 km of open grassy or mixed open-thornveld = 0.16 fatalities/km/yr
Thicket or wooded: 3 fatalities in 95.6 km of bush-encroached or thornveld = 0.03 fatalities/km/yr **Open grassy areas 5-fold higher fatalities than thicket**

The avifauna assessment concluded that:

- A high death rate of 0.66 birds/km/yr are killed on power lines in southern Namibia and this is a conservative estimate, unadjusted for scavenger removals;
- At the above fatality rates, the new 400 kV transmission line is forecast to kill approximately (462 x 0.66 birds/km/year =) 305 birds per year, without mitigation:
  - 91% of these (278 bustards and vultures) are expected to be Red Data birds
  - Overall, 32% higher fatality rate occurs under 400 kV lines than 220 kV lines (0.45 birds/km/yr) in southern Namibia.
- Open gravel or grassy habitats in the Dwarf Shrub Savannah, which occurs in the southern sections of the proposed line showed five-fold higher fatalities of Red Data bustards than other habitats and requires special attention.
- The proposed routing also goes through known Red Data vulture breeding areas in the *Vachellia erioloba* savannah of the Kalahari biome and should be avoided. The proposed transmission line route, currently under consideration, has therefore been revised to avoid impacts on these known existing avifauna "hotspots" (vulture breeding areas south of Rehoboth and the bustard habitat in dwarf shrub savannah), as far as possible. This was done through input from the environmental consultants and relevant specialists together with NamPower to identify suitable routing options, to avoid and reduce potential negative impacts on these sensitive avifaunal areas. The areas which have been avoided as a result of the re-alignment include the (i) vulture breeding areas on the farms Wilderness Rem, Battle and Friesenland, and (ii) the open gravel and grassy plains of Dwarf Shrub Savannah.
- The report further proposed that the realignment of the lines and following the existing 400 kV line (western route alternative), in addition to "staggering" or offsetting the pylons (the tower of one is aligned with the mid-span of the adjacent line; see Figure 6, and Section 11 below), is expected to be reduced the high bustard fatality rate to an acceptable level.

The above avifauna assessment considers the potential impacts of constructing and operating (including monitoring and maintaining) the proposed transmission line and its associated infrastructure (e.g. access track) on the avifauna within the 461 km and 500 m wide transmission line corridor, and region (see Section 9 below).

The approach of staggering, or offsetting the pylons with the existing transmission line, will provide an opportunity for this new approach to be tested, with an aim to obtain information on whether the proposed mitigation approach may assist in reducing bustard deaths, where none of the previous conventional mitigation measures such as bird markers seem to have been effective in reducing bird collisions. This approach will, be ratified and refined with other bird specialists as part of the pre-construction monitoring exercise, and as part of the finalization of the design, in preparation of a robust monitoring plan in the BMP.

An additional benefit of following the western alternative is that it reduces the length of the line by approximately14-16 km (depending on the exact routing) and is located further away from the Hardap Dam (a major source of waterbirds that may impact on the line).

The potential impact of birds on the proposed transmission line is considered negligible if the proposed mitigation and management action is strictly adhered to (particularly the staggered pylon alignment [Figure 6] adjacent to the existing 400 kV line [the western route that was considered as the preferred route during the 2018 study]).

None of the anticipated impacts associated with the alignment of the new 400 kV line with the existing 400 kV line (western route), during both the construction and operational phases, cannot be mitigated to an acceptable level of significance.

5.1.3 Key findings of the review of the avifauna specialist study (Simmons 2018) and its recommendations (African Conservation Services [ACS] 2019)

- High numbers of Ludwig's Bustard and Kori Bustard collisions have been recorded in the open (Karas Dwarf) shrubland, on the eastern/220 kV route; however, the survey effort has been lower on the 400 kV line, and current results indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas.
- Apart from the revised alignment of the new power line route, the avifauna assessment report (Simmons 2018) has also recommended a staggered pylon design as one of the primary mitigations to consider. The review has found that there would be a greater natural staggering effect in a 220 kV/400 kV combination (see Figure 6 below), which in the 400 kV/400 kV combination would mostly need to be achieved by design as span lengths are the same, and therefore more difficult and costly to achieve from a technical point of view (NamPower pers. comm.). However, the collision risk for either of the two combinations could also potentially be increased by staggering, as cables (including conductors, optical fibre ground wires and earth wires) would be at different heights on the two structures, especially at midspan, thereby increasing the potential density of the barrier presented to any flying birds. It is possible that stay wires also play a role in such collisions.

  Conventional power line marking (with both bird flappers and static devices) has been shown to have limited success in avoiding bustard collisions in southern Africa (Shaw *et al*. 2021). The alternative staggering method as a mitigation should therefore be tested; however, the importance of rigorous pre- and post-construction monitoring of the new line is emphasised, and the need for an adaptive management strategy to be in place.
- A high concentration of waterbirds, including at least 10 Red Data species, is associated with the Hardap Nature Reserve Important Bird Area (including the Hardap Dam), with a high risk of waterbird collisions. The 220 kV route is relatively closer (10 km) to the dam and associated irrigation schemes (and other potential attractants) than the 400 kV route (20 km). Therefore the 220 kV is more likely to lie on potential bird flightpaths. The cumulative impact on birds between the two routes at the Hardap Dam is therefore likely to be relatively lower in the case of the 400 kV line (western route alternative), as it is further away from the dam. However, the 400 kV line (western route alternative) crosses the Fish River and its associated aquatic habitats and should therefore be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds associated these habitats.

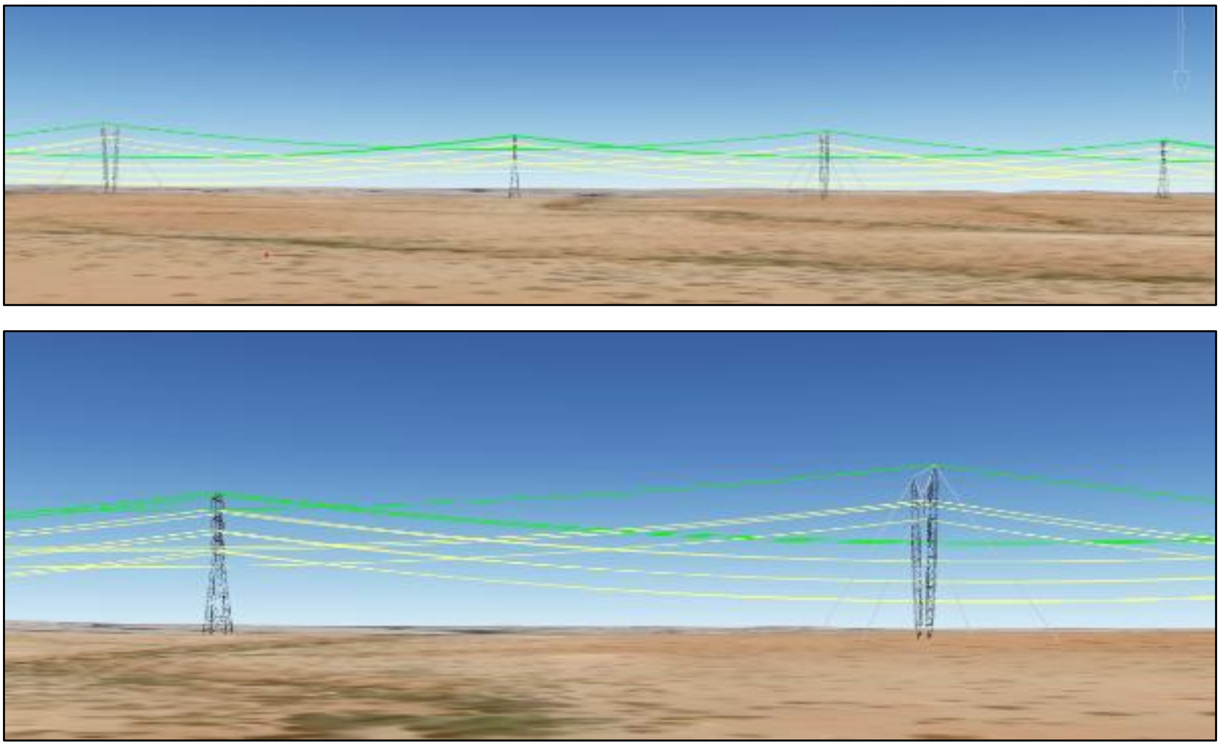

Figure 6. Examples of "staggering" or offsetting of the planned guyed 400 kV and existing self-supporting 220 kV power line structures (yellow lines = conductors; green lines = optical ground/earth wires [OPGWs]); the intended centre-line distance between the two structures is 46 m (power line modelling provided by M van der Merwe, NamPower pers. comm. 2023).

5.1.4 Subsequent amendment to the avifauna assessment (Simmons 2020)

As indicated in the avifauna assessment that was done by Simmons 2018, the project area supports a relatively high diversity of bird species with Red Data species, including vultures, eagles and bustards, as mentioned in Section 5.1.3, that are particularly vulnerable to power line collisions.

It is considered that the main impact pertaining to birds is related to potential collisions, once the line is operational. The 2018 assessment initially recommended that the western alternative route, as the preferred option to avoid sensitive bird areas, and to "stagger" (offset) the pylon towers with those of the existing 400 kV route as a mitigation (see Pallett *et al*. 2022 for details of the above proposed mitigation measure; Figure 6). The western route option, which follows the existing 400 kV line, is however technically problematic for NamPower, since the new 400 kV line would have to cross the existing 220 kV line, which may result in a high risk of potential power outages of both lines. Taking the technical constraints into consideration, a review of the 2018 avifauna study and recommendations was done (ACS 2019; see above). The review concluded that the differences in impact on avifauna (in particular, on bustards) between the two route options (western route following existing 400 kV vs eastern route following existing 200 kV) is marginal. From a technical point of view it was, therefore, proposed that the eastern alternative route should be considered as the final preferred option.

The avifauna specialist has communicated that the eastern route is accepted on condition that the pylon towers are staggered throughout, and that the 400 kV pylon towers are kept at the same height as the 220 kV towers (to increase the chance of bustards seeing and clearing both lines) and, where staggering is not possible, that the line be marked with bird flight diverters.

5.2 Updated distribution maps for key bird species

Updated distribution maps for the focal bird species (Figures 7 to10) indicating both Southern African Bird Atlas Project 1 (SABAP1) bird atlas data[3], and recently uploaded SABAP2 bird atlas maps[4], were used to supplement the existing baseline information.

In terms of the more recent SABAP2 data (dating from 2012 to the present), the CHAA is likely to be relatively poorly atlased (apart from the northern parts of the area). The SABAP1 data (dating from 1987-1992) appear to show greater coverage, although considered dated. The results should therefore be interpreted holistically, and with caution.

[3] **(SABAP1, as part of the Namibian Avifaunal Database/www.the-eis.com; Simmons *et al*. 2015; Brooks *et al*. 2022)**

[4] **(https://sabap2.birdmap.africa; 15 July 2023)**

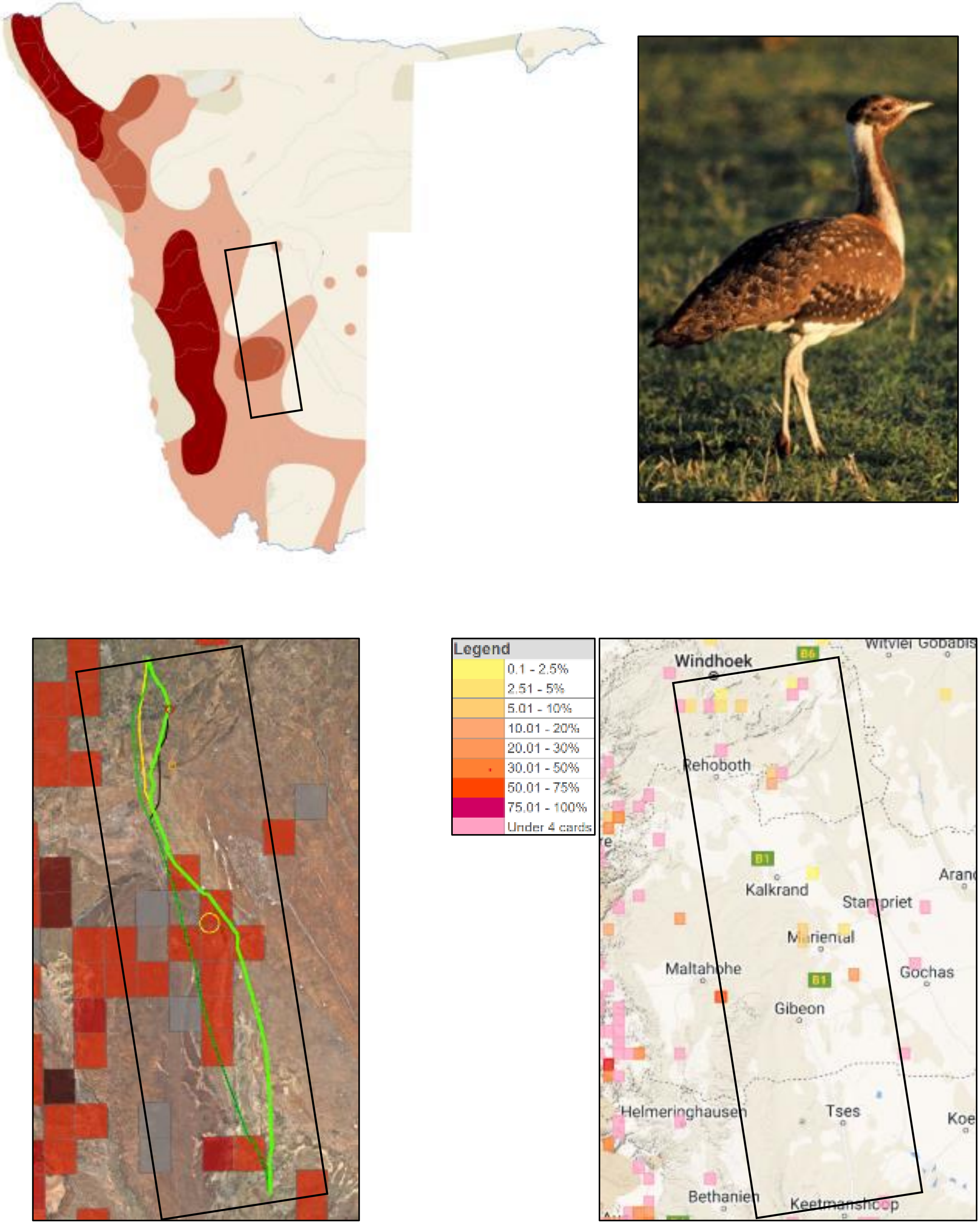

Figure 7. Distribution of **Ludwig's Bustard *Neotis ludwigii*** (Globally Endangered, Namibian Endangered) (Map with Namibian Avifaunal Database data, including SABAP1 data, & photo above: Simmons *et al*. 2015; maps below: SABAP1 data [left] and SABAP2 data [2023; right; inset: key to recording rates]; focal study area indicated by black polygon).

Figure 8. Distribution of **Kori Bustard *Ardeotis kori*** (Globally Near Threatened, Namibian Near Threatened) (Map with Namibian Avifaunal Database data, including SABAP1 data, & photo above: Simmons *et al.* 2015; maps below: SABAP1 data [left] and SABAP2 data [2023], right; focal study area indicated by black polygon).

Figure 9. Distribution of **White-backed Vulture *Gyps africanus*** (Globally Critically Endangered, Namibian Critically Endangered) (Map with Namibian Avifaunal Database data, including SABAP1 data, & photo above: Simmons *et al.* 2015; map below: SABAP1 data [left] and SABAP2 data [2023; right;\]; focal study area indicated by black polygon).

Figure 10. Distribution of **Secretarybird *Sagittarius serpentarius*** Globally Endangered, Namibian Vulnerable. (Map with Namibian Avifaunal Database data, including SABAP1 data, & photo above: Simmons *et al*. 2015; maps below: SABAP1 data [left] and SABAP2 data [2023; right]; focal study area indicated by black polygon).

5.3 Power line incidents on record for Namibia

The NamPower/Namibia Nature Foundation Strategic Partnership[5] has documented wildlife and power line incidents from 2009 to the end of 2020, involving some 848 individuals (EIS 2023). Due to the difficulty of obtaining records in bush-encroached areas (especially in the northern and north-eastern parts of the country), low reporting rates and the high scavenging rates in general, it is likely that the incidents observed are an under-estimate. Of the recorded power line incidents, those in the vicinity of the CHAA are shown in Figure 11-13 below. Additional fatality records for the power lines to the south of the CHAA, in similar habitats, were provided by P Cunningham (pers. data 2021; Figure 13b); these records are not yet reflected on the above database.

According to the database, the top five bird collision groups in the greater Namibia are flamingos (39%), bustards/korhaans (27%), raptors including vultures as well as eagles, snake eagles and owls (10%); and waterbirds (11%). Most of the incidents (90%) have comprised collisions; however, electrocutions (10%) are also an ongoing concern.

It is not possible to produce cumulative estimates of mortality based on the above data, as not many repeat surveys were completed on the same sections of power line, especially in the South. The data set also includes incidental records. A total of 236 dedicated power line surveys covering 5,193 km of varied power line structures throughout Namibia were conducted between 2009-2017. A total of 450 fatalities of various species were recorded and used to produce a mean estimate of 0.09 fatalities/km surveyed (NamPower/ Namibia Nature Foundation Strategic Partnership database 2019; *in litt.* 2019; EIS 2023).

The field surveys conducted for the proposed 400 kV transmission line in September 2017 (Simmons 2018) yielded the following results, namely 13 bustard carcasses over 157 km, providing a comparable estimate of 0.08 mortalities/km surveyed, with little difference in the number of mortalities between 220 kV and 400 kV lines. Open grassy habitat was five times more likely to sustain bustard mortalities than closed thornveld thicket; bustard mortalities were highest in the open (Karas Dwarf) shrubland in the south – particularly in open gravel/grassy plains areas.

The systematic monitoring data (unadjusted for bias) for 325 power line fatalities recorded between 2012 and2013 in the Keetmanshoop area (J Pallett *in litt*., in prep.) indicated a total estimate of 0.66 fatalities/ km/year on the 400 kV line, and of 0.45 fatalities/km/year on the 220 kV line (32% less than the 400 kV line). These incidents are not yet reflected on the above database, as the data are *in prep*. In this data set eight of the 13 species fatalities recorded were Red Data species; and 246 (76%) of the total fatalities recorded were bustards, predominantly Ludwig's Bustards (133 or 54% of 246). However, it must be noted that the above figures are a more accurate estimate of cumulative annual mortality, as they are based on several repeat surveys of each section of power line that were carried out per year; as such, these estimates are not directly comparable with the first-mentioned estimates (mortalities per km surveyed).

The avifauna study for the EIA (Simmons 2018) estimates that the proposed 461 km 400 kV transmission line could result in a minimum of (462 x 0.66 birds/km/year) 305 bird mortalities per year without mitigation. In terms of this forecast, it can be estimated that approximately 91% (231 bustards and 47 vultures) of the fatalities are expected to be Red Data birds. As part of the pre-construction data collection, and preparation of a robust monitoring program as part of the BMP, the cumulative effect that the additional line will have on bird collisions will be further investigated and confirmed.

[5] **(http://www.nnf.org.na/project/ nampowernnf-partnership/13/5/5.html)**

Bird mortality data obtained during a more recent power line survey conducted in October 2018 in the south of the proposed new line (NamPower/NNF Strategic Partnership, Scott & Scott *in litt*.; Figure 13a) is provided below:

- Kokerboom-Aries 400 kV, 12 mortalities (including 8 bustards) over 31 km = 0.38 mortalities/km surveyed; and
- Kokerboom-Harib 220 kV, 6 mortalities (including 5 bustards) over 25 km = 0.24 mortalities/km surveyed.

A recent review of bustard collisions on a global scale (Silva *et al*. 2023 and authors therein) has collated a total of 1,538 Ludwig's Bustard collision incidents in South African and Namibia, on both transmission and distribution lines; and a total of 121 Kori Bustard collisions on transmission lines.

In the South (the greater study area), J Pallett (in prep.) has recorded 0.32 Ludwig's Bustard collisions/km/year on transmission lines, and 0.09 Kori Bustard collisions/km/year on the same lines. These rates are similar to the mean of 0.34 bustard (Ludwig's and Kori Bustard) collisions/km, for surveys covering 138 km in the South (2009-2019; Scott & Scott 2020), but lower than the rate of 1.12 Ludwig's Bustards/km/year) for transmission lines and 0.86 Ludwig's Bustards/km/year for distribution lines in the Karoo, South Africa, and 0.10 Kori Bustards/km/year on transmission lines in the Nama Karoo (Shaw *et al*. 2018).

Bustard collision rates are thus highly variable but, overall, suggest that the high mortality suffered by these two species in southern Africa is of conservation concern.

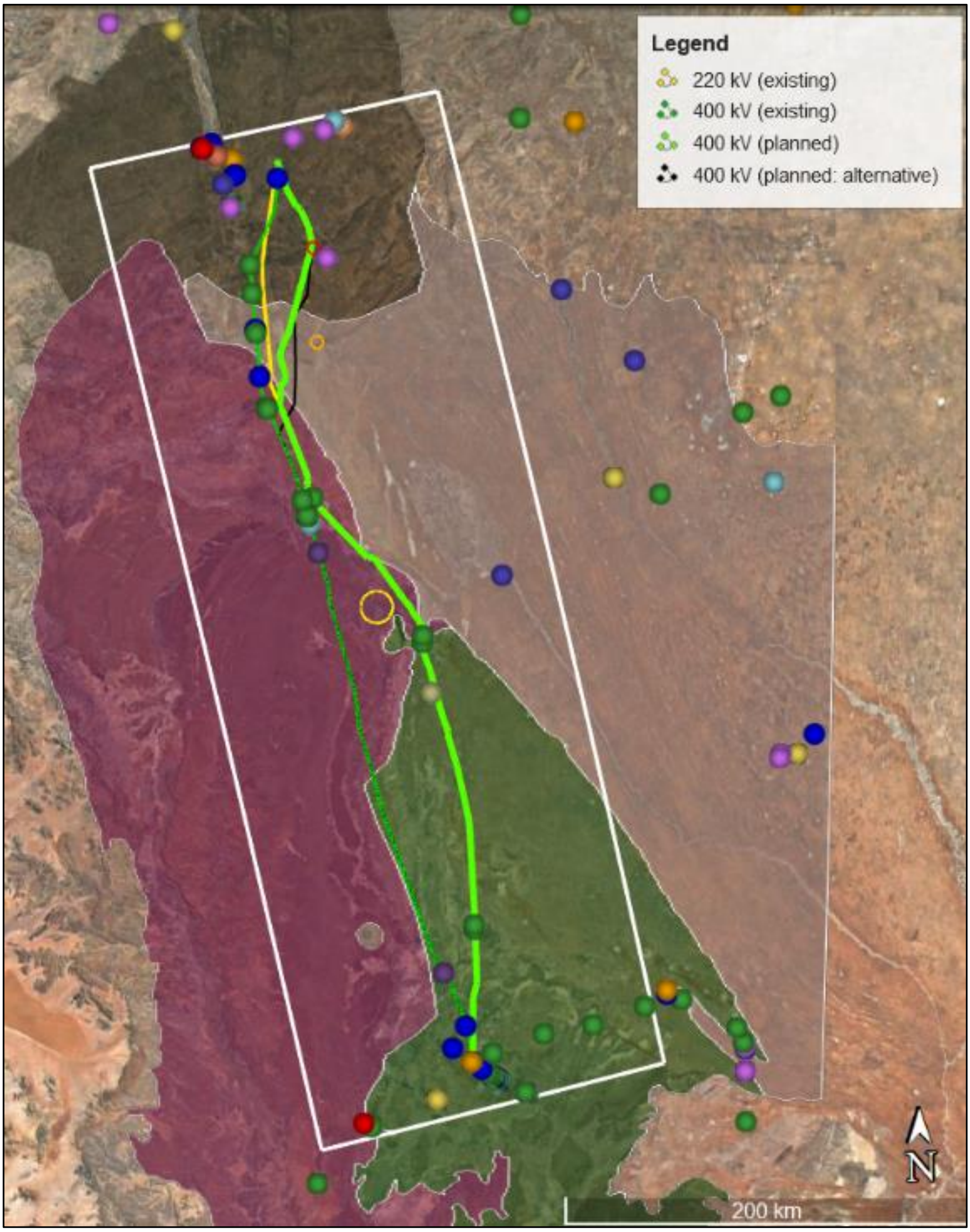

Figure 11. Overview of bird and power line incidents on record for the greater study area and focal study area (white polygon; EIS 2023; but excluding pers. data J Pallett and P Cunningham; also see Figure 12 & 13 below, with key to species); vegetation types are also indicated (see Figure 1 for key).

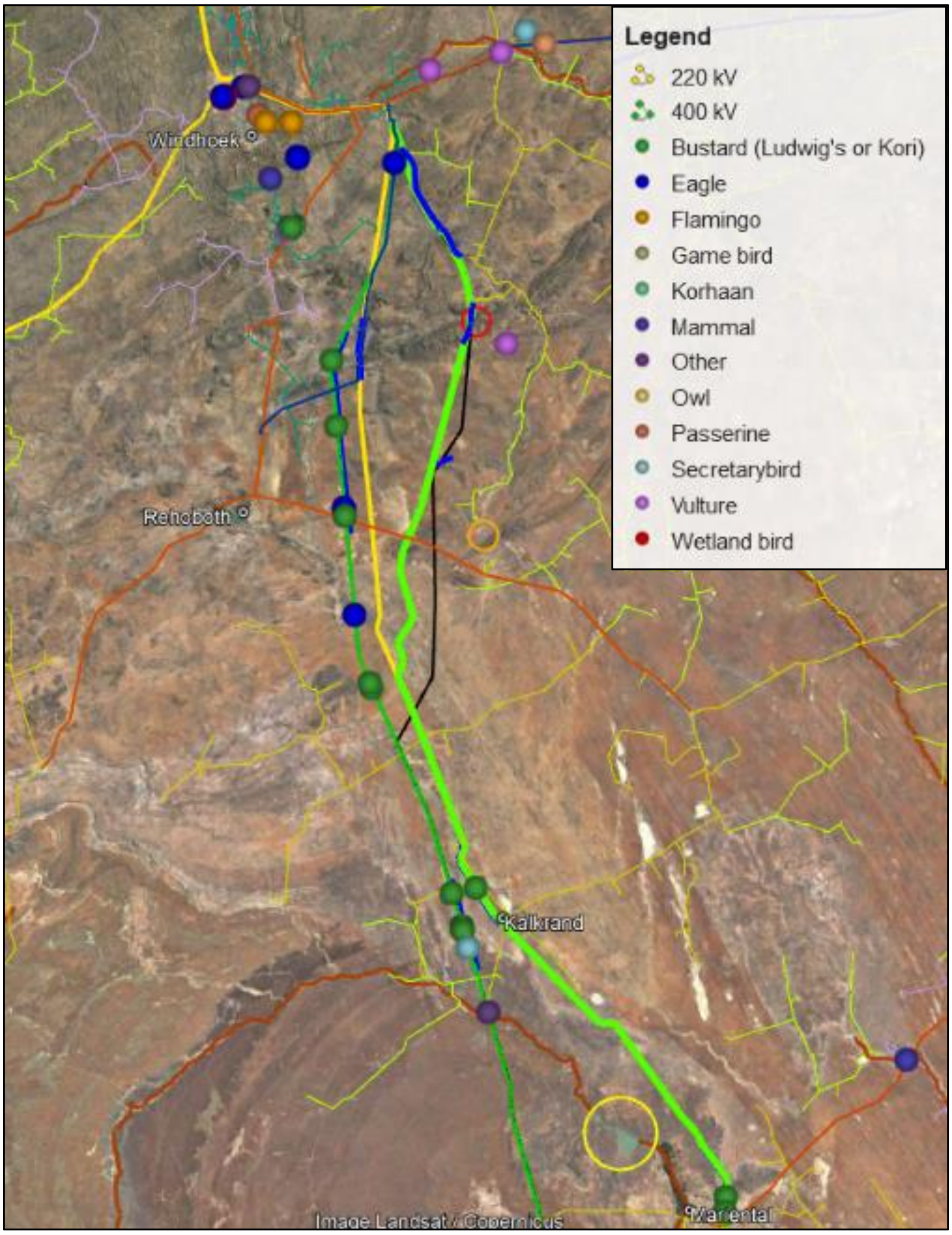

Figure 12. Detail of bird and power line incidents on record for the northern part of the greater study area in Namibia (EIS 2023; but excluding pers. data, J Pallett and P Cunningham).

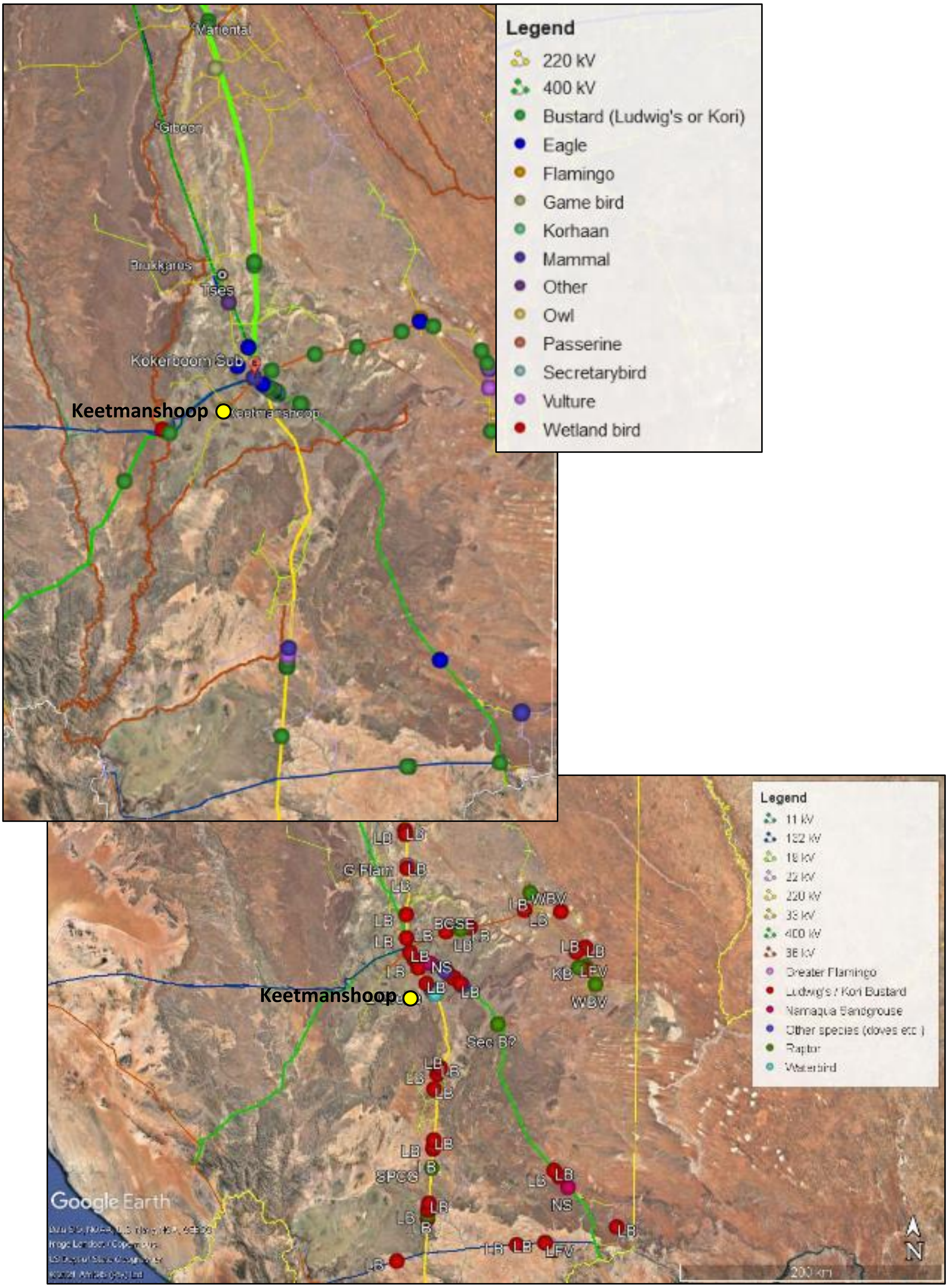

Figure 13. a. Detail of bird and power line incidents on record for the southern part of the greater study area and the area to the south, with comparable habitats and power line structures (EIS 2023; but excluding pers. data J Pallett). b. Additional records provided by P Cunningham (2021) in the area south of the greater study area. b. Additional mortality records provided by P Cunningham (pers. data 2021).

6 Critical Habitat Assessment: avifauna

WB ESF-ESS6 Paragraph 23. ***Five Criteria of a Critical Habitat (see Section 2.3 above)***

Critical Habitat is defined as areas with high biodiversity importance or value, including:

(a) Habitat of significant importance to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or equivalent national approaches.

(b) Habitat of significant importance to endemic or restricted range species.

(c) Habitat supporting globally or nationally significant concentrations of migratory or congregatory species.

(d) Highly threatened or unique ecosystems.

(e) Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above in (a) to (d).

The following factors may be regarded as indicators that the study area may contain areas of Critical Habitat in terms of bird species of potential concern; however, there are uncertainties due to the lack of Global and/or local population estimates for some species and dated estimates of populations or estimates that are not directly comparable. The lack of specific local population estimates for the study area needs to be addressed, in terms of monitoring over the longer term. A precautionary approach is thus required.

Based on the initial screening of potential species of concern (see Appendix 3 for full details), the bird species assessed are therefore grouped into (1) species with high-medium confidence in the assessment; and (2) those where the confidence in the assessment is lower. Species likely or not likely to be impacted are indicated.

6.1 Assessment of Critical Habitats for key Bird species with high-medium

6.1.1 Species with high-medium confidence and likely to be impacted

Family Otididae: Ludwig's Bustard *Neotis ludwigii*
Rare in Karas Dwarf Shrubland, uncommon in Dwarf Shrub Savanna (Simmons 2018)
Population estimates: Global 114,000 (2015); Namibia 56,000-81,000[6]
Area of Occupation (Namibia, southern Botswana, South Africa): 342,000 km^2
Criterion (a) triggered: Habitat in the study area of significant importance to Globally Endangered and Namibian Endangered species
Criterion (b) not triggered: Southern African near endemic species (40% of global population in Namibia), but not endemic species
Criterion (c) not triggered: Congregatory but small groups; partial migrant
*Relatively high frequencies of power line collisions for bustards have been reported in Namibia, and in all four habitats in study area, in particular, the collision data indicated a high observation (recorded data) of Ludwig bustard collision, predominantly in the south of the line near Keetmanshoop (Kokerboom substation), in addition to Mariental and Kalkrand.

6 (https://datazone.birdlife.org/species/factsheet/ludwigs-bustard-neotis-ludwigii/text)

Confidence: medium (the population estimate for the study area will be confirmed and updated as part of the monitoring program that will be established for this project and will be set out in the BMP)

Background information: According to the Namibian Red Data Book, Ludwig's Bustard is near-endemic to southern Africa, with a range centred on the dry biomes of the Karoo and Namib. It is found predominately in the western Namibia (Scott *et al*. 2015 and references therein) and in much of western and south-central South Africa and extends in the extreme south-west of Angola and the Southern tip of Botswana (Scott, Shaw and Pallett)[7]. This bustard species is sparse to locally common and is a nomad and partial migrant. It occurs in areas receiving <500 mm rainfall, including open lowland and upland plains with grass and light thornbush, sandy open shrub veld and semi-desert, typically on flat terrain. It forages by walking slowly and pecking close to the ground, and by darting after large insects, including grasshoppers. Eggs are laid on bare ground in a shallow scrape. The breeding rate is slow. Available nesting records indicates that there very little to no Ludwig Bustard breeding activity along the line[8], with some breeding sites (12) occurring just north of the hardap dam (see figure below), however the information is considered to be outdated.

Observed breeding site for Ludwig Bustard birds near the line route

In South Africa, collision with overhead wires associated with power infrastructure constitutes the major threat. Recent collision rates (corrected for survey biases) of 1.12 per km (95% confidence interval) have been estimated on power lines (Shaw *et al*. 2018). In Namibia, over 30% of all recorded power line collision mortalities involve this species. The extent of power lines across the range of Ludwig's Bustard is vast and expanding. Considering the high mortality rates due to collisions and the relatively small global population, it is anticipated that such collisions alone will cause a rapid decline in the population in future.

Ludwig's Bustard was uplisted to globally Endangered in 2010, after recent research suggested that the population had undergone a very rapid decline due to collisions with power lines. A recent large-scale experiment in South Africa has demonstrated that conventional line marking reduces power line collision mortality for some large terrestrial birds, but not bustards (Shaw *et al*. 2021). Bustards have

[7] http://www.the-eis.com/atlas/sites/default/files/Ludwig%27s_Bustard.pdf

[8] http://www.the-eis.com/atlas/?q=nest-records-all&dynamic-taxon_meaning_list=2056&filter-taxon_meaning_list=2056

restricted forward vision, which may explain their high susceptibility to collisions, and the apparent lack of mitigation effectiveness of marking these lines (Martin & Shaw 2010, Martin 2011).

The above population trends are of concern and are thus set to continue, as successful mitigation measures are yet to be designed and implemented (Silva *et al*. 2023).

Impacts are likely to be high in Karas Dwarf Shrubland (206 km eastern route [E]; 144 km western route [W]) and Dwarf Shrub Savanna (141 km [E]; 183 km [W]), and medium-low with mitigation (power line staggering; marking); and low in Southern Kalahari (46 km [E]; 40 km [W]) and Highland Shrubland (75 km for both alternatives)

Throughout its range, Ludwig's Bustard competes with increasing, cumulative impacts of human activity that also result in a decrease in suitable habitats. In view of the above impacts, the large areas of open, sparse grassland habitat in the study area, are therefore likely to be of significant importance, and should therefore be considered as **Critical Habitat**, for Ludwig's Bustard.

Family Sagittariidae: Secretarybird *Sagittarius serpentarius*

Uncommon in Karas Dwarf Shrubland, Southern Kalahari, Highland Shrubland; rare in Dwarf Shrub Savanna (Simmons 2018).

Population estimates: Global 6,700-67,000; Namibia 4,050

Criterion (a) not triggered: Globally Endangered, Namibian Vulnerable species but not Critical Habitat

Power line collisions reported in Namibia and in Karas Dwarf Shrubland, Dwarf Shrub Savanna, Highland Shrubland in the study area. From the available collision data in the study area; secretary bird collisions seem to be predominantly on the existing 400KV line with an observation recorded near Kalkrand and the other another north-east of Windhoek, outside of the proposed route alignment (Figure 12).

Confidence: medium-high

Background information: According to the Namibian Red Data Book, the Secretarybird is widely distributed in throughout southern Africa, and is found throughout Namibia at low densities (Simmons 2015 and references therein). It is most frequently encountered in the north-central protected areas of the country, especially within the Etosha National Park and nearby farmland.

A widespread apparent decline of this species is reported in South Africa. While data from the more recent Namibian bird atlas data (SABAP2) are much sparser than those from SABAP1, the same reduction in range from known former areas of concentration is apparent.

Unlike any other raptors, Secretarybirds spend hours walking slowly across open habitats searching for prey. They feed primarily on insects, especially orthopterans (insects with straight wings), although numerous other types of prey are also taken, including a wide range of vertebrates disturbed in short grasslands. They build large nests in the top of Acacia thorn trees.

Habitat alteration through overgrazing and bush encroachment, and habitat loss through ploughing and cultivation can reduce the Secretarybird's preferred open grassland habitat, and populations are thought to have decreased for this reason in parts of South Africa. Environmental change, including the intensification of bush encroachment may therefore also have important implications for this specie. They are also vulnerable to disturbance.

Additional threats are posed by the expanding power line grid. Secretarybirds are vulnerable to power line collisions, electrocutions and entanglement in telephone lines, possibly because of low-level flights between foraging patches. Power line collisions or electrocutions have also been recorded in Namibia. Secretarybirds may be as susceptible to collisions as bustards, particularly if their movements are also in response to local rains.

Impacts likely to be medium-high in Karas Dwarf Shrubland (206 km [E]; 144 km [W]), Southern Kalahari (40 km [E]; 46 km [W]), Highland Shrubland (75 km for both alternatives); and medium-low in Dwarf Shrub Savanna (141 km [E]; 183 km [W]); and medium-low with mitigation (power line staggering; marking).

Throughout its range, the Secretarybird competes with increasing, cumulative impacts of human activity that also result in a decrease in suitable habitats. The large areas of open, sparse grassland habitat in the study area are likely to be important, in view of the above impacts, but are not considered as critical habitat, for this species, however should be viewed as sensitive from a conservation point of view. This criterion of ESS6 of critical habitats is not triggered, due to the relatively wider distribution of the species throughout Africa.

Family Accipitridae: White-backed Vulture *Gyps africanus*

Common in Southern Kalahari, uncommon in Karas Dwarf Shrubland, Dwarf Shrub Savannah, Highland Shrubland. In Namibia, it is found most abundantly in Etosha National Park and in regions to the north-east where populations of large ungulates are intact[9].

Population estimates: G (Africa) 270,000; Namibia ~10,000

Criterion (a) not triggered: Globally Critically Endangered, Namibian Critically Endangered species, but not Critical Habitat

Criterion (c) not triggered: Congregatory, colonial breeder; but too few birds to qualify (50-100 birds, with nests, recorded at one site east of Rehoboth; proximity of the new 400 kV power line to this site has already been reduced in the 2020 EIA). Power line collisions reported in Namibia, is in the north of the proposed line in the Highland Shrubland vegetation type (Figure 12

Confidence: high

Impacts likely to be high in Southern Kalahari (40 km [E]; 46 km [W]), and medium with mitigation (routed away from sensitive breeding area; power line staggering; marking); and medium-low in Karas Dwarf Shrubland (206 km [E]; 144 km [W}), Dwarf Shrub Savannah (141 km [E]; 183 km [W]), Highland Shrubland (75 km for both alternatives)

The recorded breeding/congregational site (50-100 birds) in the greater study area is important, however the requirements of ESS6 for critical habitats for this species is not triggered.

Family Accipitridae: Lappet-faced Vulture *Torgos tracheliotos*

Common in Southern Kalahari, uncommon in Highland Shrubland

Population estimates: Global 6,500-8,000; Namibia 1,350

Criterion (a) not triggered: Globally Endangered, Namibian Endangered species but not Critical Habitat

Criterion (c) not triggered: Congregatory but too few individuals to qualify (<80 birds)

Power line collisions reported in Namibia and in study area (Karas Dwarf Shrubland)

Confidence: high

Impacts likely to be medium in Southern Kalahari (40 km [E]; 46 km [W]), and low with mitigation (power line staggering; marking); impacts low in Highland Shrubland (75 km for both alternatives)

The habitats in the study area are likely to be important for the species, from a conservation point of view but does not trigger the requirements of a critical habitats.

Family Accipitridae: Verreaux's Eagle *Aquilla verreauxii*

Common in Karas Dwarf Shrubland, uncommon in Dwarf Shrub Savanna and in Highland Shrubland

Population estimates: Global tens of thousands; Namibia 1,350-2,700

Criterion (a) not triggered: Namibian Near Threatened species

Confidence: high

[9] http://the-eis.com/elibrary/sites/default/files/downloads/literature/White-backed_Vulture_2015.pdf

Impacts: the power line will pass 1.1 km away from two identified nest sites for the species, i.e. within an identified buffer zone in Highland Shrubland; impacts thus likely to be high in this vegetation type (75 km for both alternatives), and medium-low with mitigation

The identified breeding site is sensitive however, this species does not trigger the requirements as stipulated in paragraph 23 of the WB ESS 6 for critical habitats.

Family Pelicanidae: Great White Pelican *Pelecanus onocrotalus*
Common in Dwarf Shrub Savanna
Population estimates: Global 265,000-295,000; Namibia 3,000-4,000
Criterion (a) not triggered: Namibian Vulnerable species
Criterion (c) not triggered: Congregatory: important concentrations at Hardap Dam (mass breeding area) but species is not Endangered or Critically Endangered
Power line collisions reported in Namibia
Confidence: high
Impacts likely to be low in Dwarf Shrub Savanna (141 km [E]; 183 km [W]); and very low with mitigation (power line staggering; marking; standard mitigations for electrocutions)

The Hardap Dam is an important breeding ground for the species, but **not likely to be impacted as critical habitat.**

6.1.2 Species with high-medium confidence and unlikely to be impacted

Family Accipitridae: Cape Vulture *Gyps coprotheres*
Rare in Dwarf Shrub savanna (only); rare throughout Namibia
Population estimates: Global 9,600-12,800; Namibia <20
Criterion (a) not triggered: Globally Vulnerable, Namibian Critically Endangered species but not Critical Habitat
Criterion (b) not triggered: Southern African near-endemic, but numbers very low
Criterion (c) not triggered: Congregatory/colonial breeder: but very little/no breeding, numbers very low
No power line collisions reported in Namibia

Confidence: high

Impacts likely to be very low in Dwarf Shrub Savanna (141 km [E]; 183 km [W])

The requirements as stipulated in paragraph 23 of the WB ESS 6 for critical habitats is not triggered for this species.

Family Accipitridae: Martial Eagle *Polemaetus bellicosus*
Uncommon in Karas Dwarf Shrubland, Dwarf Shrub Savanna, Southern Kalahari; rare in Highland Shrubland
Population estimates: Global tens of thousands, SA 1,620; Namibia 945
Criterion (a) not triggered: Globally Endangered, Namibian Endangered but not Critical Habitat
Power line collisions reported in Namibia and in Karas Dwarf Shrubland
Confidence: medium-high
Impacts likely to be low in Karas Dwarf Shrubland (206 km [E]; 144 km [W]), Dwarf Shrub Savanna (141 km [E]; 183 km [W]), Southern Kalahari (40 km [E]; 46 km [W]) and very low in Highland Shrubland (75 km for both alternatives), and very low with mitigation (power line staggering; marking)

The requirements as stipulated in paragraph 23 of the WB ESS 6 for critical habitats is not triggered for this species.

Family Accipitridae: Booted Eagle *Hieraaetus pennatus*
Uncommon in Dwarf Shrub Savanna, rare in Karas Dwarf Shrubland
Population estimates: Global 150,000-195,000; Namibia 250
Criterion (a) not triggered: Globally Least Concern; Namibian Endangered species but not Critical Habitat
No power line collisions reported in Namibia
Confidence: high
Impacts likely to be very low in Karas Dwarf Shrubland (206 km [E]; 144 km [W]), and in Dwarf Shrub Savanna (141 km [E]; 183 km [W])

The requirements as stipulated in paragraph 23 of the WB ESS 6 for critical habitats is not triggered for this species.

Family Accipitridae: Tawny Eagle *Aquila rapax*
Uncommon in Highland Shrubland, rare in Dwarf Shrub Savanna, Southern Kalahari
Population estimates: Global 100,000-499,999; Namibia 1,500
Criterion (a): Globally Vulnerable; Namibian Endangered species but not Critical Habitat
Power line collisions reported in Namibia and in Dwarf Shrub Savanna
Confidence: high
Impacts likely to be low in Highland Shrubland (75 km for both alternatives) and very low in Dwarf Shrub Savanna (141 km [E]; 183 km [W]) and Southern Kalahari (40 km [E]; 46 km [W]), and very low with mitigation (power line staggering; marking).

This species does not trigger the requirements for critical habitats.

Family Ciconiidae: Black Stork *Ciconia nigra*
Rare in Dwarf Shrub Savanna
Population estimates: Global 24,000-44,000; Namibia 140
Criterion (a) not triggered: Globally Least Concern; Namibian Endangered species but not Critical Habitat
No power line collisions reported in Namibia
Confidence: high
Impacts likely to be very low in Dwarf Shrub Savanna (141 km [E]; 183 km [W])

The requirement for critical habitats is not triggered for this species.

Family Phoeniculidae: Violet Wood-Hoopoe *Phoeniculus damarensis*
Rare in Highland Shrubland
Population estimates: Global not available; Namibia 1,850
Criterion (a) not triggered: Globally Least Concern; Namibian Endangered species but not Critical Habitat
Criterion (b) not triggered: Namibian near endemic species, low numbers
No power line collisions reported in Namibia
Confidence: medium
Impacts likely to be very low in Dwarf Shrub Savanna (141 km [E]; 183 km [W]) (impacts may include disturbance and habitat modification)

The requirement for critical habitats is not triggered for this species.

6.2 Bird species of concern with lower confidence in the Critical Habitat Assessment

6.2.1 Species with lower confidence and likely to be impacted

Family Otididae: Kori Bustard *Ardeotis kori*
Common in Karas Dwarf Shrubland, uncommon in Dwarf Shrub Savanna, rare in Highland Shrubland
Population estimates: Global not available (2,000-5,000 SA); Namibia 5,000-10,000
Criterion (a) not triggered: important/probably significant concentrations but status is Globally Near Threatened, Namibian Near Threatened
Criterion (3) not triggered: Congregatory: does not qualify (only small groups of males congregate)
*Power line collisions for bustards reported in Namibia (relatively high frequencies) and in all four habitats in the study area; species is highly prone to power line collisions

Confidence: medium-low (no global population estimate; no estimate for the Namibian (or local) population)

Background information

According to the Namibian Red Data Book, the Kori Bustard is found throughout Namibia, but more frequently in the east (Pallett 2015 and references therein). In Namibia's protected areas, it is most common in the Etosha National Park. Suitable habitat occurs in north-central Namibia, outside of the park, but its occurrence is more limited, probably due to the density of rural settlements. Throughout its range, the Kori Bustard is uncommon to locally common, but is generally declining in range and abundance.

The dry grasslands and open woodlands of the Kalahari represent the typical and most preferred habitat. It inhabits semi-arid to arid savannah and grassland, usually near the cover of bushes and trees. The nest is a shallow scrape in the ground, in woodland or low-tree savannah. The diet includes a wide range of animals and plants, including armoured crickets.

Collision with overhead power lines is a major threat. In southern Namibia, surveys of power lines in the Keetmanshoop area over one year revealed a mortality rate of about 0.1 Kori Bustard / year / km (JR Pallett unpubl. data), with the application of correction factors leading to an estimate of about 2,000 mortalities for the species on power lines in Namibia every year. Bustards have restricted forward vision, which may explain their high susceptibility to collisions, and the apparent lack of mitigation effectiveness of marking these lines (Martin & Shaw 2010, Martin 2011). Bush encroachment, such as has taken place in Namibia over the past 50 years, has also been shown to be linked with a loss of bird species associated with open savannah. An expanding human population is causing gradual loss of open habitat, together with fragmentation by infrastructure such as roads, fences and power lines.

Impacts likely to be high in Karas Dwarf Shrubland (206 km [E]; 144 km [W]) and Dwarf Shrub Savanna (141 km [E]; 183 km [W]), and medium-low with mitigation (power line staggering; marking); and low in Highland Shrubland (75 km for both alternatives)

Throughout its range, the Kori Bustard competes with increasing, cumulative impacts of human activity (including bush encroachment) that also result in a decrease in suitable habitats. The large areas of open, sparse grassland habitat in the study area are therefore likely to be critical habitat, in view of such impacts; however, **this criterion for a critical habitat as stipulated in ESS6 is not triggered** due to the Near Threatened (Global and Namibia) status of the species. At the present rate, it is possible that this status will be uplisted in the future.

Family Psittacidae: Rüppell's Parrot *Poicephalus rueppellii*
Common in Southern Kalahari, uncommon in Highland Shrubland
Population estimates: Global estimate not available; Namibia 29,500 (13,000-46,000)

Criterion (b) not triggered: Globally Least Concern; Namibian near endemic species, but not endemic; low numbers
No power line collisions reported in Namibia
Confidence: low (population estimate for study are not available)
Impacts likely to be low-medium in Southern Kalahari (40 km [E]; 46 km [W]), and low in Dwarf Shrub Savanna (141 km [E]; 183 km [W]) (impacts may include disturbance and habitat modification)

The requirement for critical habitats is not triggered for this species.

Family Bucerotidae: Damara Hornbill *Tockus damarensis*
Rare in Dwarf Shrub Savanna and in Highland Shrubland
Population estimates: Global not available; Namibia not available; (recently described)
Criterion (b) not triggered: Namibian near endemic species, but not endemic; low numbers
One power line collision reported in Namibia
Confidence: low (population estimates, including for study area, not available)
Impacts likely to be low in Dwarf Shrub Savanna (141 km [E]; 183 km [W]) and in Highland Shrubland (75 km for both alternatives) (impacts may include disturbance and habitat modification)

The requirements as stipulated in paragraph 23 of the WB ESS 6 for critical habitats is not triggered for this species.

Family Bucerotidae: Monteiro's Hornbill *Tockus monteiri*
Rare in Dwarf Shrub Savanna and in Highland Shrubland
Population estimates: Global not available; Namibia 339,500
Criterion (b) not triggered: Namibian near endemic species, but not endemic; low numbers
No power line collisions reported in Namibia
Confidence: low (population estimate for study are not available)
Impacts likely to be very low Dwarf Shrub Savanna (141 km [E]; 183 km [W]) and in Highland Shrubland (75 km for both alternatives) (impacts may include disturbance and habitat modification)

The requirements as stipulated in paragraph 23 of the WB ESS 6 for critical habitats is not triggered for this species.

6.2.2 Species with lower confidence and unlikely to be impacted

Family Accipitridae: Black Harrier *Circus maurus*
Rare in Dwarf Shrub Savanna, rare in Highland Shrubland
Population estimates: Global <1,000; Namibia <50
Criterion (a) not triggered: Globally Endangered, Namibian Endangered but not Critical Habitat
No power line collisions reported in Namibia

Confidence: Low

Impacts likely to be very low in Dwarf Shrub Savanna (141 km [E]; 183 km [W]) and in Highland Shrubland (75 km for both alternatives)

The requirements as stipulated in paragraph 23 of the WB ESS 6 for critical habitats is not triggered for this species.

6.3 Assessment of habitats, in terms of the Critical Habitat Assessment

ESS6 requires a differentiated risk management approach to habitats, based on their sensitivity and values. The vegetation types which occur within the study area, (Section 4) is largely considered to fall within the definition of natural habitats as defined in ESS 6. These vegetation types is not considered as critical habitat from a plant species composition point of view. The following discussion relates to critical habitat when considering the avifauna species which occur within the vegetation habitats along the proposed transmission route alignment.

6.3.1 Critical Habitat

ESS6 defines Critical Habitat as areas with *high biodiversity importance or value*, including, "*Habitat of significant importance to Critically Endangered or Endangered species*, *as listed in the IUCN Red List of threatened species or equivalent national approaches."*

Both Karas Dwarf Shrubland and Dwarf Shrub Savanna vegetation types contain large areas of open, sparse grassland habitats, with more substantial woody species being largely confined to drainage lines and the verges of seasonally wet depressions and pans (as described by Giess 1998). These open, sparse grassland habitats are typically used by Ludwig's Bustard (Globally Endangered, Namibian Endangered), as well as by Secretarybird (Globally Endangered, Namibian Vulnerable), and Kori Bustard (Globally Near Threatened, Namibian Near Threatened). These preferences are supported by available bird distribution data (see Section 4.2 above) and also by power line incident data for the above species (Section 4.3).

These open, sparse grassland habitats are considered **Critical Habitat for Ludwig's Bustard**.

Although the term Critical Habitat would not apply in the case of the second two species (although potentially similarly impacted, see above), both would also benefit from any conservation measures in this regard. Ludwig's Bustard would thus serve as a flagship for conservation efforts for all large, terrestrial bird species using these habitats.

Even though the grasslands habitats are considered of importance for the wellbeing of the species, the risk of this specific project to the species is predominantly due to potential collisions with the power line, rather than the habitat *per se* being destroyed. As noted, since the project is linear with a narrow strip of vegetation cover being removed, habitat destruction is relatively minimal (as indicated in Table 0-1) compared to the size of the habitat. Alignment of the corridor with an existing 220 kV transmission line further limits habitat destruction and fragmentation. Further mitigation measures to prevent unnecessary habitat destruction will be provided in the BMP.

The above habitats will fall within the area to be mitigated by the recommended staggering of 400 kV and 220 kV power line pylons (i.e. running in parallel with the pylons of the two structures, apart from the final 122 km, where the new proposed 400 kV line will deviate from the existing 220 kV alignment), together with adaptive management in the form of retro-fitting of markers or other mitigation in problem areas.

It is recommended that both pre-construction and post-construction monitoring should be initiated, to provide more reliable, long term baseline data on the local population status and trends of the above species in these habitats (ESF Guidance Note 11.3).

6.3.2 Sensitive avifauna habitats: "hotspots"

The potential sensitive avifauna "hotspots" within the habitat categories that are of particular sensitivity are outlined below (also see Figure 1 for localities). These areas may not fall within the category of critical habitat but should be considered as sensitive from a conservation point of view, therefore precautionary measures should be taken:

- Dwarf Shrub Savanna: the Hardap Game Park is a nationally protected area (244 km^2, with 260 bird spp.), and includes the Hardap Dam, also overlapping with the Hardap Nature Reserve Important Bird Area (IBA). Even though the power line route does not traverse these areas, the relevant sections of power line passing this area should be monitored for bird interactions, as a priority.
- Southern Kalahari: a sensitive bird "hotspot" lies 15 km east of the power line, with White-backed Vulture breeding area/congregatory area (50-100 birds + nests) and bustard habitat; this sensitivity has already been avoided/mitigated by re-routing the power line.
- Highland Shrubland: the planned power line will pass through a narrow mountain pass 1.1 km from two nests of Verreaux's Eagle (and within the 10 km buffer identified in the EIA); although this section cannot be re-routed, it is recommended that it is marked as a priority to mitigate and monitor as part of the monitoring program that will be developed as part of the BMP.

7 Biodiversity risks / potential impacts

The construction of the new 400 kV transmission line will result in potential impacts to biodiversity as describe in the following sections:

7.1 Vegetation

The transmission line route is linear and the direct belt of vegetation to be removed (limited to the immediate pylon footprint and access roads) is small in comparison to the wider habitats of similar vegetation (see Table 0-1 for vegetation unit impacted). The route has also been optimized to avoid habitat fragmentation and destruction, as far as reasonably possible by aligning it with the existing 220 kV line, as previously mentioned. The following remaining risks in terms of vegetation have been identified, which are low significance if mitigation is implemented:

- Direct destruction of, or damage to, nationally protected and/or endemic plant species, *Vachellia erioloba* (renamed: *Vachellia erioloba*; IUCN LC); in particular, where dense stands have been identified along the proposed line route, just north of Kalkrand (indicated by a red circle in Figure 5). The exact extent of the potential impacts and number of trees that may need to be removed can only be established once the final design is available and the specific alignment within the transmission line corridor has been surveyed. As part of the ESMP, mitigations to avoid large trees and/or to minimize need for removal by trimming trees will be stipulated.
- Illegal collection of plant material such as wood or pods during the construction phase.

7.2 Avifauna

Four main potential impacts associated with the construction of the new 400 kV transmission line have been identified and include 1) physical disturbance of birds and habitat destruction/modification during construction (including road mortality/poaching of birds); 2) collision of birds on power line structures, and 3) electrocution of birds on power line structures, the latter two impacts being associated with the operational phase. These impacts are considered to be negative.

7.2.1 Disturbance and habitat destruction/modification

During the construction phase of the project it is anticipated that there may be limited disturbance to birds, including those of key conservation concern, as well as habitat destruction and alteration. Daily activities such as feeding, roosting and, in particular, breeding may be affected by the construction activities if not mitigated. Disturbance and habitat destruction impacts would apply mainly during construction of the new power line.

7.2.2 Bird collisions

For the present project, collisions of birds on power line structures are considered to be the main impact on avifauna, mainly pertaining to large terrestrial birds such as bustard species, as well as to raptors. This risk is highlighted in a recent review of bustard collisions on power lines globally (Silva *et al*. 2023), as well as in similar recent reports for southern Africa (Shaw *et al*. 2018, 2021).

A collision occurs when a bird in mid-flight does not see the overhead cables or structures (including conductors and/or earth/optical ground wires [OPGWs]) until it is too late to take evasive action.

These impacts could take place on any parts of the power line but are more likely in sections where the line crosses flight paths/corridors or flyways, such as water courses/drainage lines or ridges. Collisions may also take place on stay wires (which may be included on strain poles/bend points), for instance when a bird is flushed from its position on the ground, and on other associated structures. Collisions may take place even during the construction phase, once the conductors have been strung although not yet energised but occur mainly during the operational phase. Environmental conditions, including topography and vegetation, may strongly affect both exposure to collision risk, and susceptibility to collision (Jenkins *et al*. 2010).

Recent research has highlighted the fact that the most susceptible groups to collision mortality on power lines are large, long-lived and slow-reproducing birds, often habitat specialists with hazardous behavioural traits (especially flight height and flocking flight), with high spatial exposure to collision risk with power lines, and unfavourable conservation status (Jenkins *et al*. 2010; APLIC 2012; Barientos *et al*. 2012 and authors cited therein; D'Amico *et al*. 2019; see above). The collision risk is believed to be increased by factors that include a large wingspan and low manoeuvrability, nomadic/migrant habits, flying in low light, territorial or courtship behaviour, juvenile inexperience and predation.

Predominantly, this group comprises large terrestrial or wetland species (Jenkins *et al.* 2010). Gregarious species (such as vultures) are generally thought to be more vulnerable than species with solitary habits (Bernardino *et al*. 2018). A further contributory factor to bird collisions is the occurrence of a visual "blind spot" when flying forwards, which has been demonstrated in some groups of birds, including bustards, vultures, snake-eagles and storks (Martin & Shaw 2010; Martin 2011); while searching for food on the ground, or observing conspecifics. These birds thus fail to see overhead structures such as power lines in their path, especially cables.

Collisions may occur when birds cross power lines in their local, daily movements between breeding/nesting or roosting sites, and foraging areas (or between foraging areas); often such regular flights may take place at dawn and/or dusk (Bernardino *et al*. 2018). High mobility and nomadism, especially in habitats with ephemeral resources, may render bird species prone to power line interactions. In the present study, groups such as bustards are particularly susceptible to collisions due to their nomadic habits.

7.2.3 Bird electrocutions

Electrocutions of birds on power line structures are a further important impact. An electrocution occurs when a large bird is perched or attempts to perch on an electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components. An electrocution could also be caused should a large bird perch on top of a tower and send down a "streamer" of excrement that could hit a conductor, thereby bridging the gap between an earthed and a live component.

Electrocutions are, however, considered unlikely on 400 kV lines of the planned structure, as the nature of the Cross-Rope Suspension Tower structure and the way the conductor is supported results in approximately 3.0 m of clearance between different phase conductors and the structure (Lehman *et al.* 2007; K Nghitevelekwa & M van der Merwe NamPower, pers. comm. 2019 in ACS 2019). The risk of short circuits due to streamers is therefore also considered lower than on lower voltage lines, where this clearance is much less. However, the strain towers at bend points may be attractive for birds to sit on top of the structures. Fortunately, the number of bend points on either power line route is relatively limited in the Hardap Dam area, where perching by piscivorous bird species could present a risk of streamers, although such structures should receive special attention during monitoring.

The impacts are assessed in Section 8 below.

8 Impact assessment and cumulative impact assessment

8.1 Vegetation

The impacts on vegetation (Table 3 & 4; Mannheimer 2016), for both the construction and operational phases, are assessed below. A cumulative impact assessment is included in each assessment.

Table 4. Construction phase impacts on vegetation: without and with mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 1: Direct destruction to species of conservation concern, in particular protected tree species.										
Impact Description: Bulldozing and clearing of vegetation, vehicle damage.										
Without Mitigation	-	Medium	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Whenever possible trees, in particular camel thorn trees (Acacia erioloba), should be trimmed rather than destroyed. This applies particularly to the construction and operational phases. Wherever possible pylon sites should be carefully selected and placed so as to avoid pan edges, banks of rivers and other drainage lines, and large camel thorn trees. Creation of additional tracks, including those made by bulldozers and other large construction vehicles, outside of the service track should be not be permitted unless absolutely necessary.										
With Mitigation	-	Low	High	Low	Low	Low	Low	Medium	Low	High
Cumulative Impact: If impacts on *Vachellia erioloba* and unnecessary track proliferation are not controlled the cumulative damage will be greatly increased.										
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 2: Illegal wood or pod harvesting or removal of other plant species for fuel or other purposes (e.g. selling)										
Impact Description: Harvesting of wood/pods/plants/seeds for fuel, heating or selling.										
Without Mitigation	-	Medium	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Random collection of wood for fuel and/or heating should be forbidden. No harvesting of wood by operational/maintenance staff should be permitted. Any wood used by staff for any purpose whatsoever must be permitted wood supplied by the farmers along the route themselves, or be invader species wood sourced from elsewhere. Plant collection of any plants or parts thereof, including seeds and pods, should be forbidden. Penalties, including dismissal for repeat offenders, should be in place for all transgressors.										
With Mitigation	-	Low	Low	Low	Low	Low	Low	Medium	Low	Medium
Cumulative Impact: Woody vegetation in the area can very easily be heavily impacted if wood/pod removal is not controlled. Because species like *Vachellia erioloba* are so slow-growing, and often experience sporadic recruitment, impacts can be long-term. The pressures on these resources are increasing country-wide, exacerbated by charcoal harvesting, and cumulative impacts are likely to be considerable.										

Table 5. Operational phase impacts on vegetation: without and with mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 1: Direct destruction to species of conservation concern, in particular protected tree species.										
Impact Description: Bulldozing and clearing of vegetation, vehicle damage.										
Without Mitigation	-	Low	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Strict control of tracks and vehicle turning points.. Only vegetation within the access/maintenance roads should be removed, however the track footprint should be kept as minimal as possible (two-spore track). Trim large trees rather than complete removal during operation.										
With Mitigation	-	Low	High	Low	Low	Low	Low	Medium	Low	High
Cumulative Impact: If impacts on *Vachellia erioloba* and unnecessary track proliferation are not controlled the cumulative damage will be greatly increased.										
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 2: Illegal wood or pod harvesting or removal of other plant species for fuel or other purposes (e.g. selling)										
Impact Description: Harvesting of wood/pods/plants/seeds for fuel, heating or selling.										
Without Mitigation	-	Low	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Awareness raising during construction and prohibition of pod and species collection is a requirement.										
With Mitigation	-	Low	Low	Low	Low	Low	Low	Medium	Low	Medium
Cumulative Impact: Woody vegetation in the area can very easily be heavily impacted if wood/pod removal is not controlled. Because species like *Vachellia erioloba* are so slow-growing, and often experience sporadic recruitment, impacts can be long-term. The pressures on these resources are increasing country-wide, exacerbated by charcoal harvesting, and cumulative impacts are likely to be considerable.										

8.2 Avifauna

The impacts on avifauna are assessed below (Table 5 & 6; Simmons 2018). A cumulative impact assessment is included in each assessment.

Table 6. Construction phase impacts on avifauna: without and with mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Avian impacts:										
Impact Description: Generally negative given that generally areas within 100 m of the line corridor used for feeding, roosting and breeding will be disturbed, even though there are currently no such specific areas identified, including for key species discussed in this report. Disturbance can take the form of people presence (keeping red data birds away from nests) vehicle presence (keeping birds away from feeding, breeding or roosting areas) and noise disturbance (frightening red data birds from nests or displacing them from the area in general). At worst, red data birds may be poisoned or hunted by labourers employed on site, seeking to supplement their diet or income. Once construction is over birds may return within 12 months. The magnitude (intensity) is likely to be low as few Red Data birds are likely to be breeding within a few km of the line if the alignment suggested as mitigation to avoid vulture breeding area is taken up. If birds return then the impact is reversible, unless human settlements or traffic increases along the servitude. The probability of this occurring is medium and the confidence in these predictions is medium given the published research on disturbance to breeding birds										
Without Mitigation	negative	Regional	Short term	low	low	low	Short term but reversible	Medium	Moderate to low	Medium
Mitigation Description: Avoid disturbance during the winter breeding season by limiting noise, vehicle access and people traffic < 100 m of any red data species nests Ensure that labourers do not trap, shoot, poison or wilfully disturb any birds in the vicinity of the line										
With Mitigation	Reduced negative	Regional	Short term	low	low	low	Short term but reversible	Medium	Low	Medium
Cumulative Impact: Single Power line construction, on its own, has a low impact on biodiversity in an area and it is generally of short term duration. Where the power line corridor and servitude alters the landscape and allows new predators (humans, dogs, cats, crows) into an area then longer term changes are likely. Camera trap studies in South Africa's Karoo (Shaw et al. 2015b) indicate numerous predators at carcasses under power lines, some of which are not indigenous (feral cats and dogs) and others that may be there due to the pylons (crows). Thus, longer term effects of opening up new corridors are apparent on the biodiversity in such areas.										

Table 7. Operational phase impacts on avifauna: without and with mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Avian impacts:										
Impact Description: Birds are negatively impacted by power lines and associated infrastructure in two main ways: direct impact on the earth wires or conductors (rarely on the towers) and by electrocution. They may cause flash-overs when streamers from defecation span an air -gap causing a short circuit and short-term power outage down the line. One positive impact for the birds is that for some species, especially tree-nesting raptors, pylons provide perch and nesting sites where none existed previously										
Without Mitigation	Negative	Regional	Long-term	High	low	High	Reduced population size of bustards and other red data birds	High	High	High
Mitigation Description: Avoid routing the new line through all areas identified as high risk in the avian assessment. Two of the main areas are (i) the vulture feeding and breeding areas in Kalahari Sand savannah north of Kalkrand and (ii) the high bustard mortality areas in the open grassy and gravel plains of the dwarf shrub savanna south of Kalkrand. The high avian mortality rates in the Dwarf Shrub savanna are best mitigated for the collision-prone bustards by aligning the proposed line adjacent to the existing 220 kV line according to the route currently proposed and staggering the pylons. This is predicted to reduce the estimate high mortality of 300 bustards per year by at least 50%.										
With Mitigation	Negative	Regional	Long-term	Medium	low	Medium	Reduced population size of bustards and other red data birds	High	Medium	Medium
Cumulative Impact: Thousands of kilometres of high voltage power lines criss-cross Namibia and South Africa and red data birds such as bustards, cranes, and vultures are killed and less-often electrocuted on these lines. Including those killed on the smaller reticulation lines 46 000 bustards are estimated to be killed annually in South Africa (Shaw et al. 2015a) and similar figures are likely for Namibia. This is causing population declines. Thus, there are wide-spread and far-reaching cumulative effects for the collision-prone red data species in southern Africa and the staggered pylon mitigation may be the most effective means of reducing this exceptionally high mortality rate.										

9 Comparison of alternatives

The two route alternatives (eastern and western) are compared below (Table 7; see Simmons 2018 and ACS 2019 for details).

Note that no other viable route alternatives exist within the region for development of the project in habitats of lesser biodiversity value or of critical value to the bustards, which prefer sparse, open grasslands in the wider region.

The planned 400 kV transmission line runs through four vegetation types (vegetation habitats) that are relatively large in extent, ranging from 23,806 to 66,087 km^2 (Table 7; also see Section 2.4 and Figure 1, 4).

The sensitivity of the sections of the sections of power line in each vegetation habitat is assessed in Table 8 below.

Discussion

A comparison of the two power line route alternatives indicates little difference in terms of impacts on avifauna, the chief group potentially impacted being bustards. However, the western route (448 km) is overall 13 km (3%) shorter than the eastern route (461 km), and therefore potentially of a slightly lower impact. The section of power line running through the open, sparse grassland habitats (preferred by bustards) in the south is 20 km (6%) longer in the case of the eastern route, compared to the western route.

In balance, high numbers of Ludwig's Bustard and Kori Bustard collisions have been recorded in the open (Karas Dwarf) shrubland/220 kV route; however, the survey effort has been lower on the 400 kV line, with similar habitats also used by the bustards, and current results indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas.

In terms of the risk to White-backed Vulture, the eastern route (following the existing 200 kV line) is preferable to the western route (following the 400 kV line), as it is further from the sensitive areas. The Verreaux's Eagle breeding area is potentially impacted on both route alternatives; however, mitigation in the form of marking is recommended.

A high concentration of waterbirds, including at least 10 Red Data species, is associated with the Hardap Nature Reserve Important Bird Area (including Hardap Game Park and Hardap Dam), with a high risk of waterbird collisions. The eastern alternative (preferred route) is closer (10 km) to the dam and irrigation schemes (and other potential attractants) than the western alternative (20 km away), and more likely to lie on potential bird flightpaths. The cumulative impact on birds between the two alternatives in the Hardap Dam area is therefore likely to be relatively lower in the case of the western line, as it is further away from the dam. However, the Fish River and its associated aquatic habitats to the south, on the western route, should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds. The western route crosses the Fish River landscape, while the eastern route skirts it.

From a technical and financial point of view, the eastern alternative corridor alignment presents fewer technical constraints. The western alternative is considered to be technically and financially unfeasible due to the need for the line route to cross the 220 kV line in two locations, which would need the installation of costly towers to ensure safe clearance, while the close proximity of the two 400 kV lines increases the risk of a natural event causing a failure (power outages) of both lines. Further details in this regard are provided in the main ESIA document.

Table 8. Comparison of the two route alternatives (western and eastern) for the new 400 kV transmission line

Aspect		Western alternative route (W)	Eastern alternative route (E)	Comments
Total length (km)		448 km	461 km	• W is slightly shorter (13 km; 3%) than E, therefore overall impact is slightly lower
Km of power line in vegetation type (see Figure 4)	Karas dwarf shrubland	144	206	• Impact on vegetation units (%) slightly higher for E than W (E: 0,024%; W: 0,017%) • Impacts on bustards similar for W & E alternatives • Fish River and its associated aquatic habitats should also be regarded as sensitive in terms of the high potential for collisions of waterbirds, raptors and other birds
	Dwarf shrub savanna	183	141	• Impact on vegetation units (%) slightly higher for W than E (W: 0,022%; E: 0,17%) • Impacts on bustards similar for W & E alternatives • Hardap Nature Reserve Important Bird Area (including Hardap Game Park and Hardap Dam) and sensitive waterbird species: E is closer (10 km) than W (20 km); E is also closer to the irrigation schemes on the Fish River (and other potential attractants) than W, and more likely to lie on potential bird flightpaths; cumulative impact on birds between the two routes at Hardap Dam is therefore likely to be relatively lower in W, as it is further away from the dam • Fish River and sensitive waterbird species: W route runs parallel to the Fish River for ~ 190 km south of the Hardap Dam and the irrigation schemes, crossing it once and its tributaries several times. This is a considerable risk in terms of bird collisions. E is ~ 40-50 km away from the Fish River, but not closer than 10 km.
	Km in bustard habitat:	*327*	*347*	• Length of bustard habitat 20 km (6%) longer for E than for W • Total % of vegetation unit impacted by two lines: negligible differences
	Southern Kalahari	46	40	• Total % of vegetation unit impacted by 2 alternatives – similar (approx. 0,005%) • Impacts on vulture breeding area higher for W: closer to sensitive area
	Highland shrubland	75	74	• Total % of vegetation unit impacted by 2 alternatives – similar (approx. 0,05%) • Route and impacts are the same for Verreaux's Eagle breeding area
Power line fatalities recorded (examples: J Pallett *in litt.*, in prep.)		Total estimate of 0.66 fatalities/ km/ year on a 400 kV line sampled	Total estimate of 0.45 fatalities/ km/ year on a 220 kV line sampled	• Fatalities 32% less on existing 220 kV (E) than the existing 400 kV (W) line (sampling not in the study area itself but to the south, on similar lines)
Technical constraints		Presents greater technical constraints	Fewer technical constraints	• Further details in ESIA: W is considered to be technically unfeasible due to the line route requiring to cross the 220 kV line in two locations, which would need the installation of costly towers to ensure safe clearance, while the close

Aspect	Western alternative route (W)	Eastern alternative route (E)	Comments
			proximity of the two 400 kV lines increases the risk of a natural event causing a failure (power outages) of both lines
Feasibility of applying staggering mitigation	Staggering needs to be achieved by design	Natural staggering more likely	• Staggering mitigation possible for both alternatives, in addition to line markers

Table 9. Sensitivity (H, M, L, VL) of the section of power line in each vegetation habitat for planned 400kV route (eastern and western alternatives)

Vegetation type	Karas dwarf Shrubland		Dwarf shrub savanna		Southern Kalahari		Highland shrubland	
Power line route alternative	Eastern	Western	Eastern	Western	Eastern	Western	Eastern	Western
Extent of power line (km) in above habitats	206	144	141	183	40	46	74	75
4.1 High-medium confidence in CHA								
Ludwig's Bustard	C1c,3: H	Lower (shorter)	C1c,3: H	Same	C1c,3: L	Same	C1c,3: L	
White-backed Vulture	C1c: M	Same	C1c: M	Same	C1c: H	Higher (closer)	C1c: M	
Secretarybird	C1a,c: M-H	Same	C1a,c: M-L	Same	C1a,c: M-L	Same	C1a,c: M-H	
Lappet-faced Vulture					C1: M	Same	C1: L	
Verreaux's Eagle							C4: H	
Great White Pelican			C1c: L	Lower (further)				
4.2 Lower confidence in CHA								
Kori Bustard	C1c: H	Lower (shorter)	C1c: H	Same			C1: L	
Rüppell's Parrot			?C2: L	Same	?C2: L-M	Same		
Damara Hornbill			?C2: L	Same			?C2: L	
Monteiro's Hornbill			?C2: VL	Same			?C2: VL	

10 Biodiversity Risk Management: No Net Loss/Net Gain

10.1 The Mitigation Hierarchy

Biodiversity Risk Management (or mitigation) measures are based on the Mitigation Hierarchy (Figure 14), in line with the World Bank's Environmental and Social Standards (also see Bennun *et al*. 2021 for details).

This approach guides appropriate actions to achieve No Net Loss (NNL) of biodiversity, or preferably Net Gain (NG; or Net Positive Impact). Actions should be implemented in the following order of priority: 1) Avoidance, 2) Minimisation, 3) Rehabilitation/restoration and 4) Offset. To achieve NNL, all predicted negative biodiversity impacts need to be accounted for, whereas to achieve Net Gain, offsetting needs to bring an overall positive impact on biodiversity.

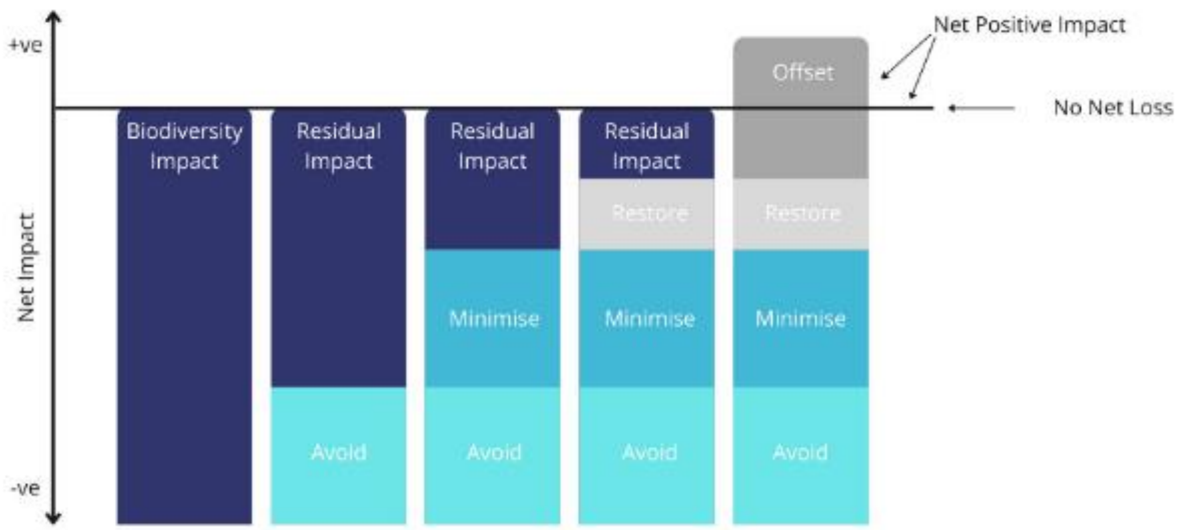

Figure 14. The mitigation hierarchy, indicating the steps of avoidance, minimisation, restoration and offset.

10.2 Mitigation, management and monitoring recommendations

The following mitigation hierarchy approach was considered for this project (see Simmons 2018, 2020 – previous specialist reports; Enviro Dynamics 2020) and will be further elaborated once additional studies have been undertaken and inputs from additional specialist on the robustness of the proposed mitigations, to achieve nett gain have been obtained which will feed into an BMP.

10.2.1 Mitigation hierarchy approach

a) Avoidance and minimization

No-go option

The reasons for the construction of the transmission line is to enable NamPower to transmit power for the growing demand to the various regions of Namibia. This includes the need to transmit power from planned renewable energy projects in the south of Namibia and to export power to other SADC countries. The no-go option will result in a deficit of power to Namibia's growing economy in the long term. There is no other alternative to transmit the power demand.

Retrofitting of existing electrical infrastructure and line routing

A recent study by Silva *et al* (2022)[10] proposed that power supply companies should consider retrofitting (upgrading) of existing power lines, as a possible measure to avoid additional impact in critical habitats. This approach is not practical from a cost point of view, due to the age of the infrastructure along the existing 220 kV line and the extended power outages that will need to occur in order for the line to be retrofitted/ upgraded. Furthermore, two lines would distribute the load and risks to ensure continued power supply to the Namibian grid. This approach is therefore not considered as a viable option for this project. Therefore, the construction of the new 400 kV line is being proposed, and impacts will need to be minimized or mitigated.

A potential approach to avoid cumulative impacts from having multiple lines within a specific area, would be to assess their proposed areas of any biodiversity sensitivity and to plan new transmission lines in such a way as to avoid these sensitive areas. However, the greater region in which the project is located is characterized by sparse, open grasslands, which are preferred habitats for the bustards, therefore moving the transmission line away from the current preferred habitat will not result in an avoidance or reduction in collision risk or impacts to the habitat types of these birds. Therefore, the impact will need to be considered for further mitigation. Aligning the servitude with an existing transmission line is preferred in order to avoid habitat fragmentation and to minimize habitat destruction.

Two major alternative routes were selected and considered during the ESIA. The impact assessment for the preferred eastern route rated marginally higher on vegetation and avifauna than the alternative western route. Comparative analysis indicates that mitigation for vegetation and avifauna is similarly possible, with the same expected results on both routes. To minimize and mitigate the avifana collision impacts a "staggering " approach has been proposed. The possibilities of following a staggering approach is relatively easier achievable on the eastern route (preffered route), but still possible on the western route. The eastern route that was selected is favoured, to avoid major technical risks.

To mitigate the biodiversity impacts of existing energy infrastructure, to assist with planning future routes, will require a survey and review of the existing power line network in Namibia to identify the occurrence and distribution of biodiversity risks, which may include both collision and electrocution of birds, also taking into account existing mitigation measures.

Impacts on biodiversity "hotspots"

The preferred eastern route has been aligned to avoid sensitive biodiversity "hotpsots", as described in this report. These include the following:

- Southern Kalahari: a sensitive bird "hotspot" lies 15 km east of the power line route, with White-backed Vulture breeding area/congregatory area (50-100 birds with nests) and bustard habitat; this sensitivity has already been avoided/mitigated by re-routing the power line.
- Pan edges, banks of rivers and other drainage lines and areas marked with large camel thorn trees, are to be avoided.

Loss of vegetation units (habitats) through clearing

[10] http://eurasianbustardalliance.org/wp-content/uploads/2022/09/Silva-et-al-2022-Bustard-powerline-collisions.pdf

The clearing of vegetation in some areas, especially along the dense *Vachellia erioloba* stand and access roads, cannot be avoided and will therefore need to be mitigated. The Engineering Team and Contractor should pay special attention to avoid clumps of trees, and other hotspots as described above, by further adjusting the route where possible. New access roads will require clearance of vegetation, to minimize the impact. The use of existing access roads will be preferred, and the creation of new access roads should be limited as far as reasonably possible. Only identified tracks should be used and construction activities strictly managed to limit impact. Large trees of conservation importance should be trimmed rather than removed.

Other measures of avoidance that can be implemented during construction and operations may include:

Disturbance to breeding birds

Before construction commences, the route should be inspected by a qualified person for any signs of breeding activity by birds, including nests and/or chicks. Signs of past breeding (e.g. old nests) should also be recorded. Avoid working in known breeding and nesting areas during breeding seasons. Further management actions and requirements for dealing with actively breeding birds will be provided in the BMP.

Poaching

Poaching should be avoided, including through the prohibition thereof in the personnel contracts and making all workers aware of this. This requires a management regime of training, management and close supervision on site. The management actions requirement for this procedure are provided in the BMP.

Avoidance of road mortalities

The Engineering Team and Contractor should be made aware of the risk of bird (and chick) mortalities due to irresponsible driving. This also requires a management regime of training, management and close supervision on site. The management actions requirement for this procedure are provided in the BMP.

10.2.2 Mitigation measures

Mitigation measures stipulated here are elaborated in the ESMP and monitoring measures will be incorporated in the BMP, where relevant.

Minimizing the destruction of habitat

Only identified tracks should be used and construction activities strictly managed to limit impact. Large trees of conservation importance should be trimmed rather than removed.

Infrastructure grouping

The proposed 400 kV transmission line has been grouped with existing infrastructure (in this case, with the existing 220 kV line) for the majority of the corridor, as far as possible, to avoid impact.

Pylon structure

The design of the towers, insulators and line configuration is important to avoid electrocution. Fitting perch dissuaders (e.g. wire brushes) above insulators or providing alternative perch sites have been used where birds foul insulators, causing short circuits. Safe pylon structure can effectively reduce electrocution risk for birds. Due to the relatively large clearances on the planned structure, namely a V-type guyed (cross rope) suspension tower (for 90% of the line) with self-supporting strain structures, electrocutions of birds are considered to be unlikely. The planned use of guy or stay wires to stabilize the towers, however, would provide an additional obstacle and collision risk to birds crossing these structures in flight. The impact therefore requires further mitigation measures to be applied.

Staggering mitigation

The new 400 kV line should run adjacent to the 220 kV line as far as possible.

The spacing of the two lines should be offset, such that the pylons of the one line align with the midspan of the other, resulting in a "staggered" design that is being tested to increase the visibility of the obstruction to flying birds and thus reduce the chances of collisions. Ideally, the two parallel lines (the proposed 400 kV and the existing 220 kV line) cannot deviate from each other for more than 2 km in any 100 km length, as this will negate the staggered pylon mitigation.

The new 400 kV line will employ pylon support towers to match the height, as far as possible, of that used on the existing 220 kV line, as part of the staggering design.

The staggering mitigation programme (see above), particularly its rigorous pre-construction and post-construction monitoring, will contribute to a better regional understanding of bird collisions and potential mitigation, and is therefore also considered an offset.

From an avian perspective, the existing 220 kV line runs, largely unmitigated, through habitat that holds high densities of the most collision-prone threatened group – the bustards. As such, by running another line adjacent to it, with staggered pylons, this and the new line can potentially provide mitigation for each other.

Line marking

Line marking (i.e. fitting the line with bird flight diverters [BFDs] to increase visibility) has been shown to reduce bird collision mortalities for various bird groups (APLIC 2012; Silva *et al*. 2023 and authors therein; also see Section 8 above). However, conventional marking with BFDs has been found to be less effective for bustard species, including in southern Africa (Shaw *et al*. 2021).

For this reason, the above novel mitigation method of staggering the towers with those of adjacent lines (see above) is being tested in the present project. Where such staggering is not possible, any sensitive sections of line should be identified and marked proactively with conventional BFDs. Should monitoring indicate further significant problematic sections of line, reactive line marking is recommended.

This will require a commitment to monitor the line for bird collisions, and to retrofit bird flight diverters (BFDs) in recorded problem areas where necessary. The BMP will include stringent and regular monitoring for collision mortalities and make provision for reactive line marking where significant risks are recorded. Monitoring should also record the effectiveness of devices, to check that they are able to withstand the harsh environment, to ensure timeous replacement when necessary.

Specific already-identified areas to be marked:

- Fourteen km of the line near Kalkrand requires bird flight diverters as it traverses a high-risk vulture area.
- The line in the Verreaux's Eagle breeding area should also be marked in a buffer area of 10 km around the site.
- Other specific high-risk areas to be identified/confirmed during pre-construction monitoring.

10.2.3 Rehabilitation/restoration

A management instruction to remove alien *Prosopis* species where they occur along the route will be included in the BMP.

10.2. 4 Offset

After the implementation of the above measures to avoid, minimize and mitigate potential negative impacts on biodiversity, and to rehabilitate or restore habitat, offsetting should be used to achieve remaining No Net Loss or Net Gain biodiversity goals, as necessary.

NamPower has been actively involved in monitoring bird collisions for many years, through a partnership that was established with Namibia Nature Foundation in 2008. The purpose of the partnership is to address electricity supply and wildlife (birds) interaction in Namibia with the objectives to, monitor, report, research and manage electricity supply and wildlife interactions, and proposed considerations for wildlife management for the electricity network in Namibia, while also creating awareness and education about risks associated with wildlife and electricity supply, incorporate wildlife mitigations for all impacts into existing electricity supply networks and to develop an over-arching, easily accessible environmental information service to assist with achieving, the above mentioned objectives.

As a second phase to the partnership, it is being proposed to build on the existing available information for the electricity network in Namibia (current and planned). A specific objective is to identify biodiversity hotspots, in particular for the key bird species, to assist with implementation of retroactive mitigation measures of existing lines, where feasible, and with the planning of future power lines, which will need to avoid these areas as far as reasonably possible.

As part of the proposed project, it is anticipated that funding will be provided to support the continuation of the bird monitoring program (NamPower/Namibia Nature Foundations Strategic Partnership) phase two. It is also anticipated that the program will also contribute to the monitoring of the proposed mitigations for this project with an aim to determine the effectiveness of the proposed mitigations in achieving a reduced number of bird collisions and overall net gain of the Ludwig bird population through the overall partnership program.

10.2.5 Monitoring

For this project a BMP will be prepared which will set out a short (pre-construction), medium (construction) and long term (post-construction) monitoring programme. The BMP will in particular focus on monitoring of key critical habitat areas and sensitive bird populations, to assess the effectiveness of the mitigation measures that have been proposed thus far (staggering in combination with line markers, in specified areas) with an aim to achieve Net Gain. A further aim of the monitoring is to assess local population numbers and trends of sensitive bird species (especially bustards) that are using these key critical habitat areas.

The BMP will contain the requirements for further, ongoing biodiversity monitoring during the operational phase, to evaluate how effectively the mitigation measures proposed are in achieving the Net Gain targets.

The monitoring regime to be included in the BMP will be reviewed by other avifauna specialists to ensure it is as robust as possible.

Further, ongoing biodiversity monitoring, during the operational phase will be required to evaluate how effectively the mitigation measures proposed are achieving the net gain targets. The following high-level monitoring protocol has been provided as part of the avifauna assessment (Simmons 2018) and amendment (Simmons 2020), as outlined below, and will form the bases for further strengthening and preparation of the BMP.

Survey work along sample areas of both the existing 220 kV line and the existing 400 kV line (as a control for the staggered pylons once in place), should be conducted in all four main habitats before and after construction. This should be undertaken as follows:

- by a competent ornithologist familiar with power line work and able to identify species found dead under power lines from their remains (feathers and wing bones);
- known-distance surveys to be undertaken 3-months and 9-months before construction of the two lines. The first should be undertaken in the dry season (to clear the line of any carcasses) with a follow-up survey just after the rain season (February – March);
- This should include (i) the existing 220 kV line in all four habitat types and (ii) the existing 400 KV line south to Kokerboom and include samples from all four habitats;
- surveys to be undertaken again 3-months and 9-months after construction of the line, one survey must include the wet season; this must be repeated in a second year post-construction;
- a minimum of 20% of the new line (20% of 461 km is 92 km) within all four habitats identified must be surveyed for bird carcasses along the same sections as surveyed along the adjacent 220 line in the previous surveys; this must be compared with 20% of the sampled 400 kV line west of the B1 in similar habitats;
- the number of carcasses found per km (with each carcass photographed next to a GPS with the point logged) should be compared with fatalities found along similar lengths of the other 400 kV line in similar habitats;
- specific surveys must be undertaken of the 14 km of proposed line that occurs within the high risk vulture area near Kalkrand (Figure 2). This must be included in pre-construction surveys and post-construction surveys to assess the efficacy of the bird spirals along the earth wires.
- ideally, the same sample areas as those detailed in the BBU (2017) report should be used for direct comparisons.

These data should be compared and analysed after the 3- and 9-month assessment periods, to determine the rate of fatalities occurring per km, the species involved, and if the mitigation measures (either staggered pylons or the use of bird diverters) are effective. These surveys should be undertaken with the support of NamPower officials to share and discuss all results and any challenges arising from the surveys. NamPower officials will also be required to access all the lines.

Should any additional high-risk areas be identified (numbers of bustards killed by the line exceeding 1 per km of line, or for vultures numbers killed exceed 1 per 7 km of line) then additional mitigation measures must be enacted within 3 months of the survey results.

The results should be published in local journals (e.g. *Namibian Journal of the Environment*) to publicize the results. They should also be added to the NamPower-NNF Partnership bird database, to assist with adaptive mitigation management planning, with a focus in areas classified as Critical Habitat.

A Plan of Study to obtain the additional information and preparation of the Biodiversity Management Plan is set out in Section 11 below.

11 Plan of Study and preparation of Biodiversity Management Plan

This Plan of Study explains the approach that will be adopted to obtain additional information about the bird populations within the key areas of interest (“hotspots”) identified along the proposed 400 kV transmission line route that are considered areas of Critical Habitat for the key bird species of interest.

11.1 Additional avifauna studies

There is a need for up-to-date local population estimates, particularly for Ludwig's Bustard, Kori Bustard and Secretarybird, to guide mitigation and management interventions on a local level.

Given that the above species are nomadic in response to rainfall and its effects on their habitats and foraging, such monitoring should be done to obtain representative data for at least one dry and one wet season.

Drawing from the monitoring proposal in the avifauna assessment done by Simmons (2020), the following is proposed:

A competent ornithologist familiar with power line work will be engaged to prepare a detailed study plan based on available data and knowledge of the area. The specialist will pay particular attention to ensure a robust plan for obtaining additional data in the "hotspot" areas identified in this CHA; this includes the southern areas of the line near the Kokerboom Substation, near the town of Mariental and just north of Kalkrand.

The objective of the study should be to obtain additional information on the population sizes of the key species (Ludwig Bustard and Kori Bustard) within these key hotspot areas. This will be done by updating and compiling a list of birds known to occur within the 19-quarter degree (15’ x 15’) squares through which the proposed Kokerboom to Auas 400 kV transmission line corridor runs, for each of the four vegetation types traversed from Namibia’s avifaunal database.

Additional field studies should focus on the hotspot areas, micro-habitats, high-risk collision-prone Red Data species, sensitive and high-risk areas to birds, potential flightpath conflict areas and nesting areas, while also considering the sample areas of the 2017 avifauna assessment to verify the presence of the key species and estimate the population size of the key species in each of the hotspot areas that may be impacted by the transmission line. The studies will use additional collision data obtained from identifying species found dead under power lines from their remains (feathers and wing bones), to support species confirmation and to obtain additional insight into the estimated deaths which may occur because of the line (note that this survey method will need to be repeated for accuracy). The field studies will be used to verify the hotspots for mitigation measures to be implemented along the existing 220 kV and new 400 kV line. The field studies should be planned to consider both dry and wet seasons. This will be planned also to serve as the pre-construction monitoring, which will feed into the BMP for the remainder of the avifauna monitoring and management work on the project. The field study will further determine the exact BFDs to be installed at the bird hotpots.

The additional information will then be used to verify and better understand the likelihood and significance of the impacts associated with the proposed project on the key birds and critical habitats. It will further assess the robustness of the proposed mitigation measures (staggering of the line) and refine the long-term monitoring program to be implemented as part of the BMP that will be prepared for this project.

11.2 Peer review and consultations

In an effort to ensure that the proposed mitigations and long-term monitoring program to be proposed in the BMP are robust, the specialist/NamPower will further engage with experienced ornithologists with particular knowledge of the key species (Ludwig's Bustards) and impacts on these species as a result of transmission line projects. Specialists or organizations to consider for consultation may include, amongst others, the Namibia Nature Foundation, Percy FitzPatrick Institute, BirdLife SA, Endangered Wildlife Trust etc., in addition to other conservation organizations in Namibia and specialists with a keen interest in and experience with wildlife transmission line interactions.

11.3 Vegetation

In terms of the vegetation, even though not considered Critical Habitat, the stand of *Vachellia erioloba* will be surveyed to demarcate its extent, and to determine the number of trees that may be directly impacted by the proposed new 400 kV transmission line. It is proposed that a vegetation specialist joins the survey team to complete this work. Over and above this recommendation, other mitigation measures from the existing specialist report will be incorporated in the BMP.

12 Conclusion

NamPower has submitted a request to the World Bank to fund the construction of the new Auas - Kokerboom 400 kV Transmission Line. To meet the requirements of the World Bank Environmental and Social Framework (ESF; World Bank 2016), NamPower is required to update the 2020 EIA. Enviro Dynamics has therefore been appointed by NamPower to prepare an ESIA and ESMP, with supporting documentation, updating the 2020 EIA and specialist work in line with the above requirements.

The present Biodiversity Report and Critical Habitat Assessment (CHA) has been prepared in response to these World Bank requirements. The report feeds into the ESIA report and Biodiversity Management Plan (BMP) being prepared.

Two conservation areas, namely the Hardap Game Park, to the west of the transmission line, and the !Khob !Naub Conservancy, traversed by the transmission line in the south of the CHAA , are not considered Critical Habitat in terms of ESS 6 criteria. All other habitats potentially critical, on the basis of their ecological functions, have been avoided by the route.

According to the ESS6 requirement for a differentiated risk management approach to habitats, based on their sensitivity and values, the entire CHAA is classified as natural habitat and there is no Critical Habitat as far as vegetation is concerned. In terms of habitat loss/destruction and fragmentation, these impacts are avoided by routing the line with an existing 220 kV line servitude. Because the impact of this project on natural habitat as defined in ESS6 is likely to be very low, especially over the medium to long term, provided that the recommended mitigation measures and Biodiversity Management Plan are adhered to in order to conserve protected tree species along the route, no additional measures or offsets will be required in terms of the vegetation.

With regard to Critical Habitat in terms of avifauna, the following bird species meets the CHA criteria and (with high-medium confidence in the assessment) is likely to be impacted by the planned 400 kV transmission line:

- **Ludwig's Bustard** Globally Endangered, Namibian Endangered

  Criterion (a) triggered: important concentrations of a Globally Endangered, Namibian Endangered species that is highly prone to power line collisions; large areas of open, sparse grassland are likely to be **Critical Habitat**

Both the Karas Dwarf Shrubland and Dwarf Shrub Savanna habitats contain large areas of open, sparse grassland habitats that are considered **Critical Habitat for Ludwig's Bustard** (Globally Endangered, Namibian Endangered). Two further species (potentially similarly impacted) would also benefit from any conservation measures in this regard, namely Secretarybird (Globally Endangered, Namibian Vulnerable), and Kori Bustard (Globally Near Threatened, Namibian Near Threatened). These habitat preferences are supported by available bird distribution data and also by power line incident data for the above species. Ludwig's Bustard would thus serve as a flagship for all large, terrestrial bird species using these habitats.

Even though these vegetation types are assessed as being Critical Habitat for Ludwig's Bustard, the impact of this project on the integrity of the habitat *per se* is minimal (limited habitat loss/ destruction), posing a very low threat to the species. It is rather the presence of the power line as a physical barrier in the habitat, which poses the threat in terms of potential collisions, that needs to be addressed more intentionally.

A comparison of the two power line route alternatives indicates little difference in terms of impacts on avifauna, the chief group potentially impacted being bustards. However, the western route (448 km) is overall 13 km (3%) shorter than the eastern route (461 km), and therefore potentially of a slightly lower impact. The section of power line running through the open, sparse grassland habitats (preferred by bustards) in the south is 20 km (6%) longer in the case of the eastern route, compared to the western route. In balance, however, current results indicate that collisions are taking place on most sections of power line that are surveyed in bustard distribution areas. From an electricity supply point of view, the eastern alternative corridor alignment presents fewer technical constraints, which is further explained in the ESIA document.

Biodiversity Risk Management (or mitigation) measures are based on the Mitigation Hierarchy, in line with the World Bank's Environmental and Social Standards. For the purpose of the No Net Loss (NNL) goal, the above mitigation hierarchy has been applied for the project, and recommendations are included in the Biodiversity Management Plan.

Ongoing biodiversity monitoring will be required to evaluate how effectively the above mitigation measures are achieving the NNL or Net Gain (NG) targets. It is therefore recommended that the BMP include a detailed and robust post-construction monitoring programme, using standardised approaches to achieve this goal. For the avifauna, there is a need for up-to-date local population estimates, particularly for Ludwig's Bustard, and Kori Bustard and Secretarybird, to guide mitigation and management interventions on a local level. The collection of these data will thus form part of a long-term project over at least one full year, and any immediate data gathering besides the data already presented will not significantly change the outcome of the baseline presented in this report.

In areas of Critical Habitat, the World Bank requirement is that the Borrower will not implement any project activities that have potential adverse impacts unless all of the seven prescribed conditions are met. According to the findings of the present CHA report, the requirements of ESS6 paragraph 24 (a) to (g) have been, or will be met by the mitigations that are proposed in the ESIA and ESMP, with the BMP.

In the light of what can be concluded regarding the potential impacts associated with the proposed transmission line, it is therefore considered that NamPower will be able to reduce the significance of these impacts to acceptable levels, if it implements the mitigation and monitoring measures outlined in the Biodiversity Management Plan.

It is therefore critically important that the BMP is audited to ensure compliance and that mitigation and monitoring take place as outlined therein, otherwise the impacts identified will remain unacceptable. It is considered that the Borrower's requirements will thus be addressed, based on the conditions above.

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Appendix 1. Legal framework

Legislation, conservation agreements, funders' requirements and best practice standards and guidelines for the avifauna impact assessment

The Critical Habitat Assessment is conducted in accordance with, and ensuring compliance with, the following legal requirements, agreements, best practice standards and guidelines. Of particular relevance are the requirements of the World Bank Group's Environmental and Social Standards (ESSs, notably ESS6).

2.1 2.1 Namibian environmental legislation	
Aspect	*Implication*
Namibian Constitution, 1990	Environmental conservation is entrenched in the Namibian Constitution (1990, Article 95, Promotion of the Welfare of the People), in terms of which the State shall actively promote and maintain the welfare of the people by adopting, *inter alia,* policies aimed at the following: (l) maintenance of ecosystems, essential ecological processes and biological diversity of Namibia and utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future … The above description would include the promotion of sustainable renewable energy developments, including the use of solar power generating systems.
Namibian Environmental Management Act, 2007 (Act no. 7 of 2007)	The Environmental Impact Assessment (EIA) process in Namibia is governed and controlled by the Environmental Management Act (EMA), 2007 and the EIA Regulations 30 of 2012 (Anon. 2012), which are administered by the office of the Environmental Commissioner through the Department of Environment Affairs (DEA) of the Ministry of Environment, Forestry and Tourism (MEFT). The above Act requires the full consideration of biodiversity (including birds), habitat and landscape parameters, values and criteria as part of the environmental assessment processes. Under this legislation, activities that may not be undertaken without an Environmental Clearance Certificate (ECC) include energy generation, transmission and storage activities.
Namibian Nature Conservation Ordinance No 4 of 1975	The conservation of terrestrial birds in Namibia is governed by the the Nature Conservation Ordinance No 4 of 1975. It is envisaged that the Ordinance will eventually be replaced by the (draft) Parks and Wildlife Management Bill (2005). The list of Specially Protected Birds according to this Bill is based on the Namibian Red Data Book (Simmons *et al.* 2015), and the Namibian Red Data categories in the latter document are used in the present report, together with those of a recent update (Brown *et al.* 2017).

3.1 2.2 Namibian obligations in terms of international conservation agreements	
Aspect	*Implication*
Convention on Biological Diversity (CBD) Post-2020 Biodiversity Framework	The Namibian government has an obligation to uphold the provisions of the various protocols and conventions to which it is a signatory. These include the international Convention on Biological Diversity (CBD). The CBD has three main goals, including the conservation of biological diversity (or biodiversity); the sustainable use of its components; and the fair and equitable sharing of benefits arising from genetic resources. The CBD is the overarching multilateral environmental agreement for biodiversity, with 196 Parties comprising nearly all the world's countries (Bennun *et al.* 2021). The CBD's post-2020 global biodiversity framework will build on the Strategic Plan for Biodiversity 2011–2020 and sets out an ambitious plan to implement broad-based action to bring about a transformation in society's relationship with biodiversity and to ensure that, by 2050, the shared vision of living in harmony with nature is fulfilled.
United Nations Framework Convention on Climate Change (UNFCCC)	Since 1995, Namibia has also been a signatory to the United Nations Framework Convention on Climate Change (UNFCCC), as a Non-Annex I party (NAI). The UNFCCC objective is to stabilise greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The framework sets non-binding limits on greenhouse gas emissions for individual countries and contains no enforcement mechanisms. As party to the convention, Namibia is obliged to prepare and submit National Communications (NCs) and in addition Biennial Updated Reports (BURs) (http://www.met.gov.na/services/national-communications-and-biennial-update-reports/238/). The adoption of the Paris Climate Change Agreement (2015; under the above convention) has also brought home the need for low-carbon development based on environment-friendly technologies.
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	The Convention on the Conservation of Migratory Species of Wild Animals (CMS) is an intergovernmental treaty with global remit (Bennun *et al.* 2021). CMS lists a number of migratory species that are susceptible to solar (and wind) impacts for which parties to the convention have agreed increased protection. CMS convenes the Energy Task Force, a dedicated multi-stakeholder platform that works towards reconciling renewable energy developments with the conservation of migratory species. A number of other relevant agreements and memorandums under the CMS umbrella include the Agreement on the Conservation of African-Eurasian Migratory Birds (AEWA) and the Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia (Raptors MOU). Namibia is classed as a range state for AEWA but, although guided by its principles, is not yet a contracting party to this international agreement.
United Nations Sustainable Development Goals (SDGs)	Seventeen United Nations Sustainable Development Goals (SDGs) were adopted by all UN Member States in 2015, as part of the 2030 Agenda for Sustainable Development, which set out a 15-year plan to achieve the Goals (Bennun *et al.* 2021). SDGs relevant to renewable energy and biodiversity include:

	GOAL 7: Affordable and Clean Energy - Ensure access to affordable, reliable, sustainable and modern energy GOAL 13: Climate Action - Take urgent action to combat climate change and its impacts GOAL 15: Life on Land - Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss
Important Bird and Biodiversity Areas (IBAs)	The BirdLife International Important Bird and Biodiversity Area (IBA) Programme aims to identify, monitor and protect a global network of IBAs for the conservation of the world's birds and other wildlife (Barnes 1998; Simmons *et al.* 1998; Simmons *et al.* 2001; Kolberg 2015). These areas were initially known as Important Bird Areas. IBAs are thus sites of international significance for the conservation of birds at the Global, Regional (Continental) or Sub-regional (southern African) level, selected according to a set of four criteria based on globally threatened species, restricted-range species, biome-restricted species and congregations (Kolberg 2015). However, not all IBAs receive official protection. IBAs situated in the vicinity of the CHAA include: • Hardap Nature Reserve (N016)
4.1 2.3 Funders' standards and requirements	
Aspect	*Implication*
World Bank Environmental and Social Framework (ESF; World Bank 2017)	The World Bank Group is one of the world's largest sources of funding and knowledge for developing countries (https://www.worldbank.org/). Its five institutions (including the International Finance Corporation, see below) share a commitment to reducing poverty, increasing shared prosperity, and promoting sustainable development. The World Bank Environmental and Social Framework (ESF) sets out the World Bank's commitment to sustainable development, through a Bank Policy and a set of Environmental and Social Standards (ESS) that are designed to support Borrowers' projects, with the aim of ending extreme poverty and promoting shared prosperity (World Bank 2016). The ESF includes ten Environmental and Social Standards, which set out the requirements that apply to Borrowers. These include: *ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources*: recognises that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development; it recognises the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support. The above ESS requires a differentiated risk management approach to habitats based on their sensitivity and values. This ESS addresses all habitats, categorised as 'modified habitat', 'natural habitat', and 'critical habitat', along with 'legally protected and internationally and regionally recognized areas of biodiversity value' which may encompass habitat in any or all of these categories. The objectives for ESS6 include:

	• To protect and conserve biodiversity and habitats; • To apply the mitigation hierarchy and the precautionary approach in the design and implementation projects that could have an impact on biodiversity; and • To promote the sustainable management of living natural resources. The World Bank Group Environmental, Health and Safety Guidelines are supported by the Equator Principles (July 2020), a global financial industry benchmark for determining, assessing and managing environmental and social risk in projects (www.equator-principles.com).
World Bank Environmental, Health, and Safety Guidelines for Electric Power Transmission and Distribution (World Bank 2007)	The Environmental, Health, and Safety (EHS) Guidelines for Electric Power Transmission and Distribution (World Bank 2007) include information relevant to power transmission (including environmental issues) between a generation facility and a substation located within an electricity grid, in addition to power distribution from a substation to consumers located in residential, commercial, and industrial areas. The above guidelines recommend prevention and control measures to minimise avian collisions and electrocutions, including: • Aligning transmission corridors to avoid Critical Habitats (World Bank 2016); • Considering the installation of underground transmission and distribution lines in sensitive areas (e.g. critical natural habitats); • Installing visibility enhancement objects such as marker balls, bird deterrents, or diverters; • Maintaining 1.5 m spacing between energised components and grounded hardware or, where spacing is not feasible, covering energised parts and hardware; and • Retrofitting existing transmission or distribution systems by installing elevated perches, insulating jumper loops, placing obstructive perch deterrents (e.g. insulated "V's"), changing the location of conductors, and / or using raptor hoods. The guidelines recommend that environmental monitoring programmes for this sector should be implemented to address all activities that have been identified to have potentially significant impacts on the environment during normal operations and upset conditions.
2.4 Other best practice guidelines for birds and energy development	
Other, related best practice guidelines	The International Dark-Sky Association has complied guidelines for reducing the impacts of light pollution (see www.darksky.org), which may impact on night-flying birds.

Appendix 2. Annotated list of plant species of potential conservation concern

SPECIES	CONSERVATION STATUS	RANGE IN NAMIBIA	RED DATA STATUS (NAMIBIA)	IUCN CATEGORY	CITES STATUS
***Vachellia erioloba* (*Vachellia erioloba*)**	Protected by Forestry Act	Widespread	None	LC	
Albizia anthelmintica	Protected by Forestry Act	Widespread	None	LC	
Aloe dichotoma	Protected by Nature Conservation Regulations and Forestry Regulations	Widespread, sometimes in dense stands	None	LRlc[2] (VU)	II
Aloe littoralis	Protected by Forestry Act	Widespread, sometimes in dense stands	None	LRlc (LC)	II
Boscia albitrunca	Protected by Forestry Act	Widespread	None	LRlc (LC)	
Euclea pseudebenus	Protected by Forestry Act	Widespread	None	LC	
Maerua schinzii	Protected by Forestry Act	Widespread	None	Lrlc (LC)	
Ziziphus mucronata	Protected by Forestry Act	Widespread	None	LC	

Appendix 3. Screening of (A) bird species of conservation concern (Criteria 1-3) and (B) habitat parameters (Criterion 4), for Critical Habitat Assessment

Key:

*Common and scientific names according to Simmons et al. 2015; Brown et al. 2017; Roberts Bird Guide 2016 (Chittenden *et al.* 2016)

Local abundance (after Simmons 2018): C = common; U = uncommon; R = rare

Red Data status (Simmons *et al.* 2015, Brown *et al.* 2017; red): CR = Critically Endangered, EN = Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern/Secure; G = global status; rare = now rare in Namibia

End = Endemism (Simmons *et al.* 2015, Brown *et al.* 2017; green): NE = near endemic; Nam = Namibia (≥90% of population in Namibia); s Afr = southern Africa;

Residency: Congregatory (con; brown) and migratory (mig; blue) species; par migrant = partial migrant; Pal mig = Palearctic migrant; intra-Afr = intra-African

Other conservation factors: G = global, N = Namibian; AoA = Area of Analysis (CHAA); > = decreasing, < = increasing

References: [1]Guidance notes WB EES6: 2018; [2]IUCN 2023; [3]Simmons et al. 2015; [4]after Simmons 2018; [5]NamPower/NNF Strategic Partnership database (2009-2017; EIS 2023); [6]present study

3A. Screening of bird species of conservation concern: Criteria 1-3.

BIRD SPECIES	Local abundance[4] in vegetation type				Bird species status cf. Criteria 1-3 for Critical Habitat			Other conservation factors				
	1. Karas Dwarf Shrubland	2. Dwarf Shrub Savanna	3. Southern Kalahari	4. Highland Shrubland	1. Critically Endangered & Endangered spp. [2,3]	2. Endemic & restricted-range spp.	3. Migratory & congre-gatory spp.	Area of occurrence / extent of occupancy (km^2)	Population estimates	Population trends	Power line collision incidents (Nam + AoA)[5]	Habitat preferences and sensitivity
White-backed Vulture	U	U	C	U	G CR, N CR		Con (colonial)	G 2,340,000 N 305,000 (13%)	G (Africa) 270,000 (1992) N ~10,000	G > N >	N √ AoA √ (4)	Dry, woodland savannah; resident, widespread movements. 3. Sensitive breeding area/ congregatory area (50-100 vultures + nests)
Cape Vulture	-	R	-	-	G VU, N CR	SA NE N <1%	(Con [colonial])	G 1,250,000 N 61,000	G 9,600-12,800/3,000 prs N <20?	G > N long term >	N – AoA –	Mountains, inselbergs, forages over open grassland within savannah woodland; resident with long-distance movements; no breeding in CHAA
Lappet-faced Vulture	R	R	C	U	G EN, N EN		Con	G 34,200,000 N 335,200	G 6,500 / 8,000 (Africa 1992) N 500 prs / 1,350 birds	G > N >10%	N √ AoA √ (1)	Arid savannah through to desert watercourses; resident with long-distance movements
Black Harrier	-	R	-	R	G EN, N EN	SA END N 5%		G 1,340,000 N 23,000	G 251-999 / <1000 N <50 birds / 5 prs	G > N fluc	N – AoA –	Desert floodplains, karroid scrub; seasonal movements into s Kalahari and c Namibia

BIRD SPECIES	Local abundance[4] in vegetation type				Bird species status cf. Criteria 1-3 for Critical Habitat			Other conservation factors				
	1. Karas Dwarf Shrubland	2. Dwarf Shrub Savanna	3. Southern Kalahari	4. Highland Shrubland	1. Critically Endangered & Endangered spp. [2,3]	2. Endemic & restricted-range spp.	3. Migratory & congregatory spp.	Area of occurrence / extent of occupancy (km^2)	Population estimates	Population trends	Power line collision incidents (Nam + AoA)[5]	Habitat preferences and sensitivity
Martial Eagle	U	U	U	R	G EN, N EN			G 26,000,000 N 243,000	G Tens of thousands (2001) / SA <600 prs / 1,620 birds N <350 prs / 945 birds	G > N >	N – AoA –	Grasslands, Namib, Karoo and wooded savannahs; resident
Booted Eagle	R	U	-	-	G LC, N EN		Pal mig pop (and non-breeding SA mig)	G 62,000,000 N 109,000	G 150,000-195,000 N 250 birds/ 20 prs	G ?Stable N Fluc	N – AoA –	Mountains, inselbergs (migrant + breeding populations in Namibia)
Tawny Eagle	-	R	R	U	G VU, N EN			G 52,700,000 N 237,400	G 100,000-499,999 N 1,500 birds / 530 prs	G > N > 63%	N – AoA √ (2)	Mopane, Kalahari and arid savannah woodlands; resident
Verreaux's Eagle	C	U	-	U	G LC, N NT			G 21,600,000 N 630,000	G Tens of thousands N 500-1,000 prs = 1,350-2,700	G stable N Fluc/ slight >	N – AoA –	Nama Karoo and arid savannahs with escarpments and broken, rocky mountainous terrain. 4. Sensitive breeding site on cliffs (2 nests); resident

BIRD SPECIES	Local abundance[4] in vegetation type				Bird species status cf. Criteria 1-3 for Critical Habitat			Other conservation factors				
	1. Karas Dwarf Shrubland	2. Dwarf Shrub Savanna	3. Southern Kalahari	4. Highland Shrubland	1. Critically Endangered & Endangered spp.[2,3]	2. Endemic & restricted-range spp.	3. Migratory & congregatory spp.	Area of occurrence / extent of occupancy (km^2)	Population estimates	Population trends	Power line collision incidents (Nam + AoA)[5]	Habitat preferences and sensitivity
Secretarybird	U	R	U	U	**G EN, N VU**			G 23,200,000 N 226,000	G 6,700-67,000 N <1,500 prs / 4,050 birds	G > N >	N √ AoA √ (1, 2, 4)	Open grassland, open savannah woodland, karoo shrubland; resident/ nomadic
Ludwig's Bustard	R	U	-	-	**G EN, N EN**	**SA NE N 40%**	**Par mig (Con)**	G 1,630,000 N 342,000	G 114,000 (2015) 56,000-81,000 (Nam/SA 1994)	G > N ?, >	N √ AoA √ (Habitats 1, 2, 3, 4)	Open, sparse grassland; semi-arid dwarf shrublands of succulent Karoo, Nama Karoo & Namib (rainfall <500 mm)
Kori Bustard	C	U	-	R	**G NT, N NT**		**(Con: males in br season)**	G 8,800,000 / (sAfr) N 721,000	G? 2,000-5,000 (SA)/ (sAfr) N 5,000-10,000	G ? N ? >	N √ AoA √ (Habitats 1, 2, 3, 4)	Open, sparse grassland with scattered trees (largely excluded from bush-encroached savannah); sedentary; males congregate for breeding; movements 150 km
[6]**Great White Pelican**	-	C	-	-	**G LC, N VU**		**Con (colonial)**	G 51,200,000 N 90,300	G265,000-295,000 N 3,000-4,000	G ? N > ?	N √ AoA –	Aquatic habitats, including inland dams 2. Hardap Dam and IBA; congregatory/ single mass breeding site, up to 50 nests – 1 of only 4 known breeding sites in Nam)

BIRD SPECIES	Local abundance[4] in vegetation type				Bird species status cf. Criteria 1-3 for Critical Habitat			Other conservation factors				
	1. Karas Dwarf Shrubland	2. Dwarf Shrub Savanna	3. Southern Kalahari	4. Highland Shrubland	1. Critically Endangered & Endangered spp.[2,3]	2. Endemic & restricted-range spp.	3. Migratory & congregatory spp.	Area of occurrence / extent of occupancy (km^2)	Population estimates	Population trends	Power line collision incidents (Nam + AoA)[5]	Habitat preferences and sensitivity
[6]Black Stork	-	R	-	-	G LC, N EN		Pal mig	G 25,100,000 N 66,200	G 24,000-44,000 N 140 birds	G mod depleted N >	N – AoA –	Perennial and ephemeral rivers, gorges and canyons, inland dams; est. 18 birds on Fish River; resident/nomadic
Violet Wood-Hoopoe	-	-	-	R	G LC, N EN	N NE 90%		G 3,810,000 N 36,000	G ? N 1,850/ 530 prs	G ? N stable to >	N – AoA –	Escarpment rivers and surrounding arid savannah
Rüppell's Parrot		-	C	U	G LC, N NT	N NE 90%		G 170,000 N 140,000	G ? N 29,500 (13,000-46,000)	G ? N >?	N – AoA –	Ephemeral rivers with large seed-bearing trees, highland areas, escarpment
Damara Hornbill	-	R	-	R	G LC, N LC	N NE 90%		G 414,000 N 268,000	G Widespread, locally common N (*newly described)	G ? N ?	N √ AoA –	Dry Acacia savannah to stony Mopane woodland habitat; large trees associated with ephemeral habitats
Monteiro's Hornbill	-	-	-	R	G LC, N LC	N NE 90%		G 559,000 N 224,800	G Widespread, locally common N 339,500	G ? N ?	N – AoA –	Rocky habitat; nomadic

Note: possible habitat and disturbance impacts to other Namibian near-endemic species in the CHAA (e.g. Carp's Tit, Rockrunner and White-tailed Shrike, mainly in the north-western parts of the area) are likely to be very low or minimal.

3B. Screening of habitat parameters

Criterion 4: Highly Threatened or Unique Ecosystems

GN80. **The thresholds for Criterion 4 are the following**:

(a) Areas representing ≥5% of the global extent of an ecosystem type meeting the criteria for IUCN status of CR or EN.

(b) Other areas not yet assessed by IUCN but determined to be of high priority for conservation by regional or national systematic conservation planning.

Vegetation type/ habitat and total no. of bird species[4]	**Habitat category**	**Extent (in Namibia; km²)**	**Length of power line within planned eastern 400kV servitude (n = 461 km)**	**Length of power line within alternative western 400kV servitude (n = 448 km)**	**Potentially sensitive* habitats within vegetation type**	**Bird species potentially impacted**
Karas dwarf shrubland (113 bird spp.)	• Natural	66,087	206	144	• Open, sparse grassland habitat	• Ludwig's Bustard • Secretarybird • Kori Bustard
Dwarf shrub savanna (200 bird spp.)	• Natural • Modified: Hardap Dam & agricultural irrigation areas to south	65,794	141	183	• Open, sparse grassland habitat • Hardap Game Park (nationally protected area; 244 km², 260 bird spp.) and Hardap Nature Reserve IBA: Hardap Dam is an artificial impoundment; congregatory site for waterbirds; single mass breeding site for Great White Pelican (up to 50 nests – 1 of only 4 such sites known in Namibia) • Hardap Dam (see above) and agricultural irrigation areas up to 25 km to south are modified, creating (limited) favourable habitats for birds • Rocky habitats of Fish River catchment are attractive to Black Stork, raptors	• Ludwig's Bustard • Secretarybird • Kori Bustard • Great White Pelican & other waterbirds • Black Stork • Raptors
Southern Kalahari (117 bird spp.)	• Natural	57,901	40	46	• Sensitive bird hotspot 15 km east of power line, with White-backed Vulture breeding	• White-backed Vulture

Vegetation type/ habitat and total no. of bird species[4]	**Habitat category**	**Extent (in Namibia; km²)**	**Length of power line within planned eastern 400kV servitude (n = 461 km)**	**Length of power line within alternative western 400kV servitude (n = 448 km)**	**Potentially sensitive* habitats within vegetation type**	**Bird species potentially impacted**
					area/congregatory area (50-100 birds + nests) and bustard habitat • Ephemeral pan habitats to east of line, possibly flight corridor to Hardap Dam	• Bustards • Flamingos and other waterbirds
Highland shrubland (177 bird spp.)	• Natural (bush-encroached)	23,806	74	75	• Sensitive breeding site for Verreaux's Eagle on cliffs (2 nests, 1.1 km from power line route) • Rocky mountain habitats are attractive to raptors	• Verreaux's Eagle • Other raptors

PROPOSED KOKERBOOM - AUAS 400 KV TRANSMISSION LINE

ENVIRONMENTAL IMPACT ASSESSMENT

Colonial-era defensive breastworks with firing loops, southern Namibia, September 2011 (QRS 54**)**

Archaeological Assessment Report
For Impact Assessment Report

J. Kinahan PhD
Quaternary Research Services (QRS)
P.O. Box 22407, Windhoek, Namibia

June 2016

QRS

23 June 2016

DECLARATION OF INDEPENDENCE

I, John Kinahan, as duly authorised representative of Quaternary Research Services (QRS) confirm my independence (as well as that of QRS) as a specialist and declare that neither I nor QRS have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Lithon Project Consultants (Pty) Ltd was appointed to managed the Environmental Impact Assessment (EIA) process or Ms. Jaana-Maria Ball was appointed as Environmental Assessment Practitioner in terms of the Environmental Management Act, 2007 (Act No. 7 of 2007) and EIA Regulations, 2012, other than fair remuneration for worked performed on the Kokerboom to Auas 400 kV transmission line. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – within the limitations as are described in my attached report.

My expertise and experience is as follows: (Projects undertaken in the same area)

QRS 14. *An archaeological survey of the Aries to Auas powerline route*. Report commissioned by Walmsley Environmental Consultants (Pty) Ltd. for the Namibia Power Corporation (1999). John Kinahan.

QRS 15. *A first approximation of archaeological site distributions in Namibia.* Commissioned by the Atlas of Namibia Projects, Directorate of Environment Affairs, Ministry of Environment & Tourism, Windhoek (2000). John Kinahan.

QRS 27. *Archaeological investigation of the Tses pipeline route*. Commissioned by Namibia Water Corporation Ltd. (2001). John Kinahan.

QRS 54. *An archaeological assessment of the proposed Kokerboom-Namib powerline.* Commisioned by Enviro Dynamics (Pty) Ltd. For Nam Power (Pty) Ltd. (2004). John Kinahan.

QRS 69. *Archaeological assessment of power-line routes from Auas substation to Kupferberg and Rehoboth.* Commissioned by Namibia Resource Consultants & Enviro Dynamics (Pty) Ltd on behalf of NamPower (Pty) Ltd. (2005). John Kinahan.

QRS 143. *Archaeological field survey and assessment of the Lodestone Magnetite Mine Prospect (EPL 3112).* Commissioned by Colin Christian & Associates CC. (2011). John Kinahan.

QRS 227a. *Archaeological desk assessment of the proposed Kokerboom Photovoltaic Electricity Project, Keetmanshoop, Karas Region.* Commissioned by GCS Water and Environmental Consultants (2015). John Kinahan.

QRS 227b. *Archaeological desk assessment of the proposed Hardap Photovoltaic Electricity Project, Mariental, Hardap Region.* Commissioned by GCS Water and Environmental Consultants (2015). John Kinahan.

QRS 238. *Archaeological assessment proposed railway infrastructure between Windhoek and Rehoboth, Feasibility Study Phase.* Commissioned by EcoCore Environmental Consultants (2016). John Kinahan.

Full Name: John Kinahan

Title / Position: Partner

Qualification: PhD

Professional membership: None

Experience: 36 years

Contact details: 081-3320832

EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 kV TRANSMISSION LINE, NAMIBIA

ARCHAEOLOGICAL ASSESSMENT REPORT FOR IMPACT ASSESSMENT REPORT

EXECUTIVE SUMMARY

The Archaeological Assessment presented here is based on a survey of the approximately 457 km transmission line corridor route (of 500 m width) between the Kokerboom and Auas Substations, augmented by the results of several previous surveys in the same area. The results may be considered an adequate reflection of archaeological and related sites in the project area. Palaeontological sites include Palaeozoic trace fossil exposures up to 300 million years old, while the archaeological sites span the last two million years with the mid-Pleistocene, late Holocene and historic periods being well represented.

Pleistocene stone artefact finds are associated with the generally deflated surface of the Nama Karoo Basin and the retreating scarp line of the Weissrand Plateau. In confirmation of observations from earlier archaeological surveys the Kalahari Sandveld and Khomas Hochland are generally associated with younger archaeological sites related to Holocene occupation of the central arts of Namibia. These younger sites also include a number of early colonial settlements and associated features such as cemeteries.

Most of the area to be affected by the proposed transmission line project is considered to be of relatively low archaeological sensitivity.

Negative impacts on archaeological sites may occur during the construction phase.

Potential impacts may be mitigated by adjustment of the power line alignment. Where this is not possible, mitigation to reduce the significance of the negative impacts could include the use of minimum buffer zones for the positioning of pylons, buffer zones for deviations in the servitude track, the use of high visibility barrier mesh around the sites during construction, the rehabilitation of the construction phase track used during the stringing of the transmission line, and detailed documentation as well as possible excavation of affected archaeological sites.

No specific sites are recommended for such actions at this stage. An archaeological chance finds procedure is appended to the report with guidelines for mitigation of new archaeological finds that may be made in the course of construction and operation.

EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

ARCHAEOLOGICAL ASSESSMENT REPORT FOR IMPACT ASSESSMENT REPORT CONTENTS

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GLOSSARY OF TERMS, DEFINITIONS AND ABBREVIATIONS

Acheulean	Early Stone Age technological complex less than 0.5 million years ago
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
GIS	Geographical Information System
GPS	Global Positioning System
Holocene	From 10 000 years ago, continuing
IFC	International Finance Corporation
NHC	National Heritage Council
Palaeozoic	Geological time-scale division 540 to 250 million years ago
Pleistocene	From 2 million years ago to approximately 40 000 years ago

1 INTRODUCTION

1.1 Background

This independent Archaeological Assessment forms part of the full Environmental Impact Assessment (EIA) of the proposed 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek). The Archaeological Assessment presented here will be submitted to the competent authority, the Directorate of Environmental Affairs: Ministry of Environment and Tourism (MET-DEA), for a decision as part of the overall Assessment Report. The EIA is undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966) and the EIA Regulations, 2012.

The purpose of the EIA is to assess the environmental acceptability of constructing, operating and maintaining a power-line which is approximately 457 km long. The final servitude will have a width of 44 m, 12 m of that being cleared for an access track. The access track will be used to bring in construction materials, as well as to access the power line and its associated pylons for maintenance purposes throughout the operational life of the infrastructure. No previous archaeological survey had been carried out in the area to be directly affected by the power line, and the transmission line corridor routing was determined prior to the Archaeological Assessment.

This Archaeological Assessment has been compiled within the Impact Assessment phase of the EIA. Its objective is to identify archaeological and related sites that would be affected by the transmission line project. The Assessment Report presents the results of an assessment of the archaeology of the project area as the basis for an assessment of the impacts of the proposed Kokerboom - Auas transmission line project in its various stages, including construction and operational phases (including maintenance). The Assessment Report also sets out the basic requirements for the mitigation of impacts associated with the transmission line project during the construction and operational phases.

1.2 Study Objectives

The study objectives are to assess the potential archaeological impacts of the proposed development and to set out requirements for the mitigation of the potential impacts.

1.3 Report Content

The content of the Archaeological Assessment is consistent with the requirements for specialist studies as set out in the EIA Regulations (2012) and Procedures and Guidelines for Environmental Impact Assessment EIA) and Environmental Management Plans (EMP) issued by the MET- DEA in 2008.

1.4 Details of the Principal Parties

The Project Proponent/ Applicant is NamPower (Pty) Ltd, the Namibian state power utility. The EIA process is being managed by Lithon Project Consultants (Pty) Ltd and the appointed EAP is Ms. Jaana-Maria Ball who is a registered Reviewer and Lead Practitioner with the Environmental Assessment Practitioners Association of Namibia (EAPAN). She prepared all the documentation emanating from this process.

The archaeological assessment study was undertaken by Dr J. Kinahan of Quaternary Research Services (QRS) to inform the assessment of the potential impacts arising from this proposed development. The contact details, expertise and experience as well as a Declaration of Independence by the specialist are set out at the beginning of this Report.

1.4.1 Scope of Work

The scope of work for the Archaeological Assessment is:

- Review of all known archaeological occurrences within the power-line corridors.
- Compilation of Geographical Information System (GIS) files for the archaeology of the corridors, including predicted occurrence of unrecorded occurrences.
- Field survey of the power line corridors with emphasis on areas of predicted archaeological sensitivity.
- Compilation of archaeological component to the Environmental Management Plans (EMP) for the construction and operational phases.
- Submission of the Assessment Report and proposals for mitigation measures including procedures for the handling of chance finds such as human remains discovered in the course of site development work.
- Attendance of integration meetings and ad hoc consultations.

1.5 Study Approach

The Archaeological Assessment is based on protocols developed for archaeological assessment in Namibia, intended to take into account the terms of the National Heritage Act (2004). Thus, the study aims to identify potential sources of risk posed by the proposed project. These sources of risk are specific to the archaeology of the area as it is known from existing data and the results of the additional field survey reported here.

1.5.1 Methodology

Archaeological Assessment in Namibia follows a basic three-phase process of evaluation (scoping) – usually by desk study, followed by assessment based on field survey with limited sampling and including proposals for mitigation of impacts (if required), and mitigation – involving detailed field investigation, laboratory analysis and the preparation of site management plans (if required).
The evaluation (scoping) phase was completed. The Assessment phase reported here entails direct field survey of ground not covered by previous surveys. The survey covered the proposed transmission line corridor which is approximately 457 km in length and 500 m wide. The assessment addressed all concerns and comments raised by Interested and Affected Parties (I&APs) raised during the public consultation process (PPP or Public Participation Process) that preceded this assessment.

In the field, archaeological sites are assessed according to standard criteria, including the physical setting of the site, mainly with reference to geological or topographic features, as well as the type of archaeological site and its affinity. Affinity is determined by a field estimation of the site age, cultural associations and other observations, where pertinent, on the size, density and characteristic features of the site.

Field identification of Pleistocene artefact scatters mainly followed Volman (1984) on the recognition of diagnostic pieces for purposes of relative dating. Holocene to Recent artefact scatters were recognized according to the criteria of Deacon (1984) and with reference to Kinahan (1984). Description and interpretation of nomadic pastoral sites followed Kinahan (1991).

Essential to the Assessment phase is an evaluation of the archaeological significance of the sites, and their vulnerability to disturbance in the course of project development activities, using parallel 0-5 scales. Archaeological **significance rating** reflects the value of the site to the understanding of the regional archaeological sequence, i.e. its knowledge, or research potential (see below). Significance rating does not reflect tourism or other income-generating potential. Archaeological **vulnerability rating** reflects the likelihood that the site will be damaged or destroyed by the specific project under assessment. Vulnerability rating does not reflect archaeological significance and does not reflect vulnerability to other impacts, including natural processes.

Unlike conventional assessment scales, these scales allow independent assessment of significance and vulnerability. Archaeological **sensitivity** is derived as the product of the significance and vulnerability rating, such that a site with a high significance rating and a low vulnerability rating would have a low sensitivity rating, and a site with a low significance rating and a high vulnerability rating would have a correspondingly low sensitivity rating.

SIGNIFICANCE RANKING
0 no archaeological significance
1 disturbed or secondary context, without diagnostic material
2 isolated minor find in undisturbed primary context, with diagnostic material
3 archaeological site forming part of an identifiable local distribution or group
4 multi-component site, or central site with high research potential
5 major archaeological site containing unique evidence of high regional significance

VULNERABILITY RANKING
0 not vulnerable
1 no threat posed by current or proposed development activities
2 low or indirect threat from possible consequences of development (e.g. soil erosion)
3 probable threat from inadvertent disturbance due to proximity of development
4 high likelihood of partial disturbance or destruction due to close proximity of development
5 direct and certain threat of major disturbance or total destruction

1.5.2 Assumptions and Limitations

The assumptions for the Archaeological Assessment are:

The archaeological assessment relies on the indicative value of surface finds, augmented by the results of excavations carried out in the course of previous work in the same area. Based on these data, it is possible to predict the likely occurrence of further archaeological sites with some accuracy, and to present a general statement of the local archaeological site distribution.

The limitations of the Archaeological Assessment are:

Since the assessment is limited to surface observations, it is necessary to caution the proponent that hidden, or buried archaeological remains might be exposed as the project proceeds. A further limitation, regarding the archaeological assessment itself, is that continuing development in the project area will over time raise the significance of finds reported here as the extent of undisturbed ground steadily diminishes.

1.6 Policy, Legal and Administrative Framework

The principal instrument of legal protection for heritage resources in Namibia is the National Heritage Act (27 of 2004). Part V Section 46 of the Act prohibits removal, damage, alteration or excavation of heritage sites or remains (defined in Part 1, Definitions 1), while Section 48 *ff* sets out the procedure for application and granting of permits such as might be required in the event of damage to a protected site occurring as an inevitable result of development. Section 51 (3) sets out the requirements for impact assessment. Part VI Section 55 Paragraphs 3 and 4 require that any person who discovers an archaeological site should notify the National Heritage Council (NHC).

It is important to be aware that no regulations have been formulated for the implementation of the National Heritage Act, and there is no official procedure concerning impact assessment. However, archaeological impact assessment of large projects has become accepted practice in Namibia, especially where project proponents need also to consider international guidelines. In the present case the appropriate international guidelines are those of the World Bank OP and BP 4.11 guidelines in respect of “Physical Cultural Resources” (R2006-0049, approved April 17, 2006). Of these guidelines, those relating to project screening, baseline survey and mitigation are the most relevant.

Archaeological impact assessment in Namibia may also take place under the rubric of the Environmental Management Act (Act No. 7 of 2007) which specifically includes anthropogenic elements in its definition of environment. The list of activities that may not be undertaken without Environmental Clearance Certificate: Environmental Management Act, 2007 (Government. Notice 29 of 2012), and the Environmental Impact Assessment Regulations: Environmental Management Act, 2007 (Government. Notice 30 of 2012) both apply to the management of impacts on archaeological sites and remains whether these are considered in detail by the environmental assessment or not.

Recent or historical grave sites, their conservation and possible removal where impact cannot be avoided is governed by the Burial Places Ordinance, 27 of 1966. Permits for the excavation, collection and appropriate deposition of archaeological materials are issued by the NHC, while permits for the possible removal of recent or historical graves are issued by the Office of the President.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

2.1 The Receiving Environment

2.1.1 Physical setting

The proposed Kokerboom - Auas transmission power line corridor traverses four major landscape units, namely the Nama - Karoo Basin, the Weissrand Plateau, the Kalahari Sandveld and the Khomas Hochland. Figure 1 indicates the proposed transmission line corridor and its centre line in relation to these landscape units. It shows the positions of the 25 archaeological survey quadrats examined in the course of the field assessment.

The Nama-Karoo Basin is a vast primarily colluvial sedimentary body with some extensive exposures of deeply weathered underlying Karoo formations. The basin is drained from east to west by several major ephemeral river systems including the Ganigobes, Tses and Huam. These are characterized by deeply incised streams, and more extensive but weakly developed drainage, with sparse vegetation comprising mainly scrub thornbush and narrow riparian growth on main streams.

The well-defined retreating scarp of the Weissrand Plateau lies to the east of the Nama - Karoo Basin. The surface of the Weissrand consists of deeply weathered pebbly conglomerate with some local endoreic drainage systems associated with small pans. Parts of the Weissrand are overlain by the mobile western edges of the Kalahari Sandveld and to the north of Mariental the red Kalahari dunes are a dominant feature of the landscape, with few well-developed drainage lines.

The northern section of the transmission line route traverses the rugged terrain of the eastern Khomas Hochland, characterized by rolling hills and well-developed drainage. The generally steep hillslopes of the Khomas Hochland are associated with skeletonized soils, extensive sheet erosion and restricted deposition basins. The vegetation of the Khomas Hochland comprises deciduous highland savanna, with dense riparian growth in major river valleys.

2.1.2 Archaeology

Southern Namibia is not well known archaeologically, with recorded site densities at less than 0.001/km² for the area as a whole (Kinahan & Deelie 1990). Detailed surveys indicate that a more likely density would be in the region of between 0.25 and 0.5/km², for all Quaternary sites combined (Kinahan 1997a, 1997b). Figure 2 shows the proposed route of the Kokerboom - Auas transmission line corridor in relation to the known distribution of archaeological sites.

Incidental records of archaeological sites in southern Namibia confirm that the entire Quaternary sequence would be represented, with a preponderance of Pleistocene artefact scatters. The same records suggest that mid-Holocene to Recent archaeological sites would be present, but that few of these would be attributable to nomadic pastoralist settlement dating to within the last two millennia. Rock art sites would be very scarce, as would be burial sites marked by stone cairns. Published data on early colonial settlement (Drechsler 1980; Lau 1987) suggests that a field survey would encounter evidence of early farming settlement and of military activity relating to the early anti-colonial uprisings. Pre-Quaternary fossil beds are found in the Permian Whitehill and Prince Albert Formations which outcrop in this area (Oelofsen 1981).

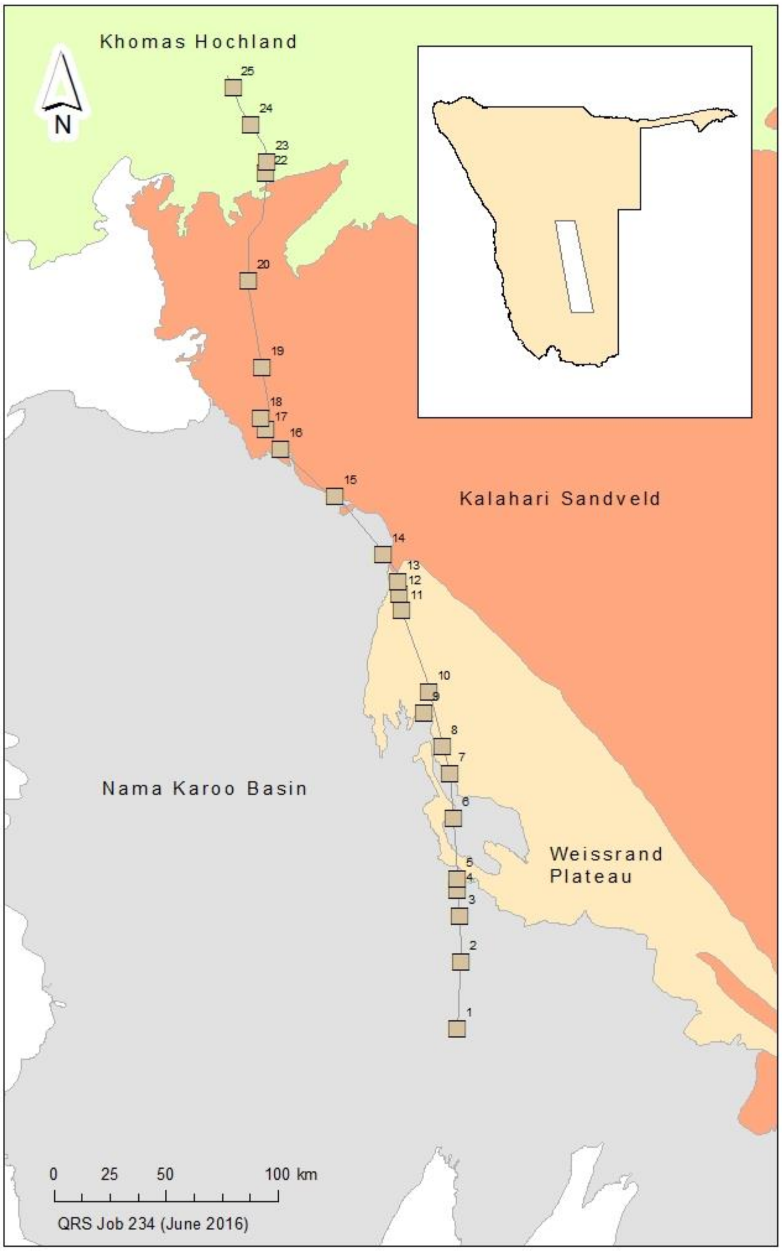

Figure 1: The proposed Kokerboom - Auas transmission line corridor route in relation to major landscape systems, and indicating the positions of 25 archaeological survey sites.

Note: the centre line of the proposed 500 m wide corridor is indicated.

An earlier survey that traversed the Nama Karoo basin (Kinahan 1999), about 25 km to the west of the proposed transmission line corridor route, recorded some minor fossiliferous Prince Albert and Whitehill Formation outcrops. A small number of early Pleistocene stone artefact occurrences with some suspected Oldowan tool scatters were also located. Mid-Pleistocene archaeological remains included isolated Acheulean bifacial tools, and Victoria West core flakes. Terminal Pleistocene finds included blade flakes with some evidence of Levallois reduction. The Holocene occupation of the area was represented by occasional scatters of stone artefact debris, while more recent occupation included minor evidence of early colonial farming activities and some possible evidence relating to the 1915 South African invasion of southern Namibia.

The present survey confirmed these observations with widespread mid- to late Pleistocene artefact scatters and some minor Holocene occurrences of artefact debris. However, none of these lay directly within the area to be affected by the proposed transmission line (i.e. within the 457 km long and 500 m wide corridor). On this section of the transmission line route corridor only two significant sites were located:

- QRS 243/604 S26.14268 E18.30721: Pre-colonial burial cairn 2m diameter, slightly dispersed, on stream terrace.
- QRS 243/605 S26.14444 E18.30861: Colonial era grave, 2.2m long, unmarked, on stream terrace.

Minor occurrences were:

- QRS 243/606 S25.95448 E18.29785: Isolated mid-Pleistocene pebble tools
- QRS 243/607 S25.85223 E18.28769: Isolated mid-Pleistocene pebble tools
- QRS 243/608 S25.81264 E18.28821: Isolated mid-Pleistocene pebble tools
- QRS 243/609 S25.55836 E18.27325: Isolated mid-Pleistocene pebble tools

A detailed local survey on the Weissrand Plateau (Kinahan 2015) located mid- to late Pleistocene stone artefact scatters mainly in fine grained quartzite. The sites had a local density of about 20 sites per square kilometre, although none of the finds were in primary context and appeared to have been affected by local sheet erosion. There was an apparently higher local density of artefact scatters associated with the western scarp of the Weissrand Plateau, although this could not be confirmed.

The present survey corroborated the earlier observations with minor occurrences at the following sites:

- QRS 243/611 S25.49677 E18.17118: Isolated mid-Pleistocene pebble tools
- QRS 243/612 S25.38665 E18.25571: Isolated mid-Pleistocene pebble tools

Archaeological survey results from the western Kalahari sandveld (Kinahan 1999) show early to mid-Pleistocene stone artefact occurrences and dense localized scatters of terminal Pleistocene stone artefacts (50 - 100 pieces/m^2). These are suspected to include early Holocene material where the scatters were found in association with seasonal pans. Other archaeological features of the Kalahari Sandveld include remains of nomadic pastoral mat house circles which probably date to within the last 1 000 years, and occasional finds of early colonial settlement. Pre-Pleistocene remains include Palaeozoic trace fossils associated with localized outcrops of the Zamnareb Formation.

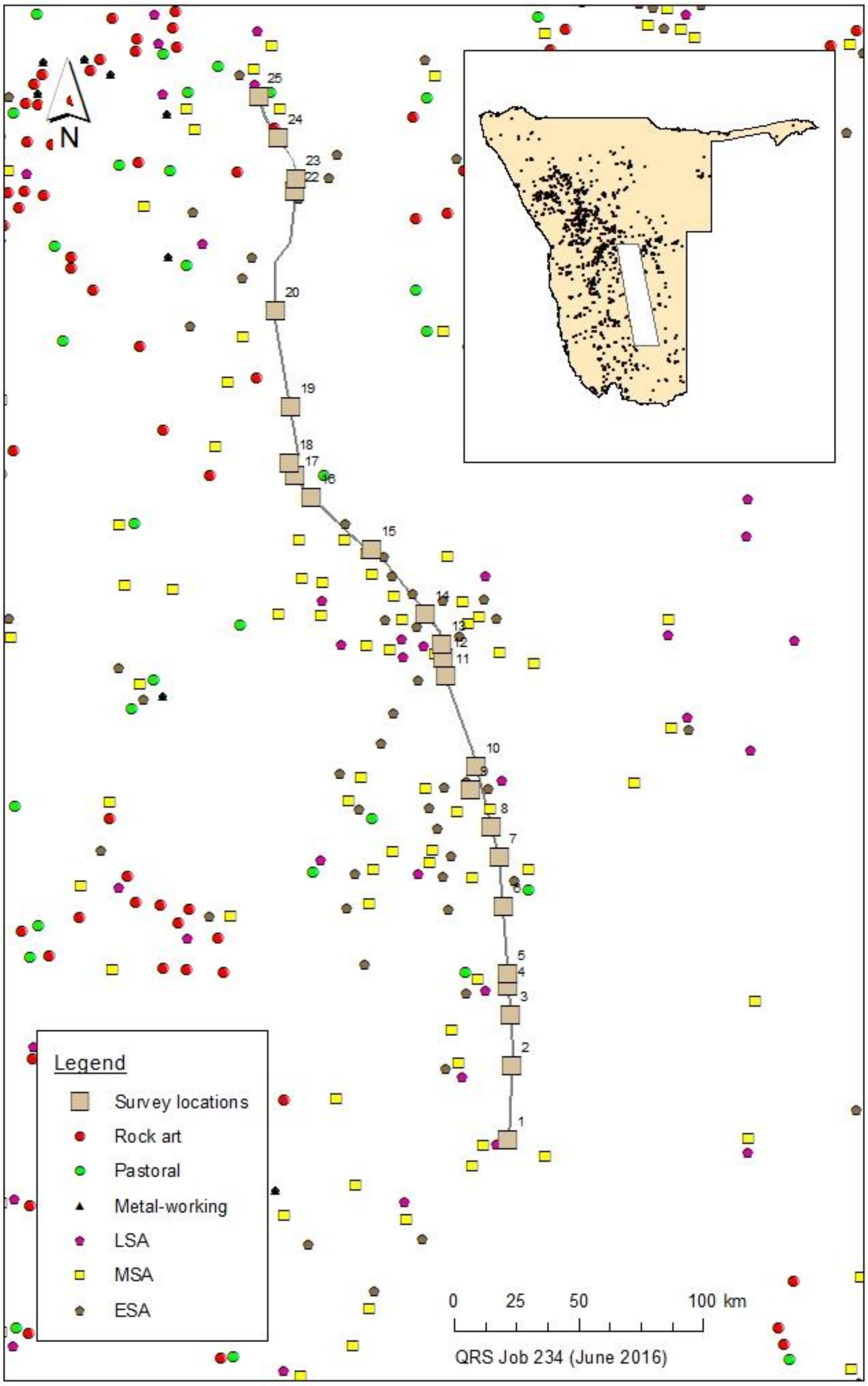

Figure 2: The proposed Kokerboom - Auas transmission line corridor route in relation to the distribution of known archaeological sites, and indicating the positions of 25 archaeological survey sites.

Note: the centre line of the proposed 500 m wide corridor is indicated.

Minor occurrences were:

- QRS 234/613 S24.07905 E17.57740: Isolated late Holocene artefact debris, chert
- QRS 234/614 S24.00543 E17.52033: Isolated late Pleistocene artefact debris, quartzite

The Khomas Hochland area is generally lacking in pre-Holocene archaeological remains (see Kinahan 1999) and this is thought to be the result of extensive sheet erosion during the last 10 000 years. Archaeological remains in this area tend therefore to be characterized by small rock shelter sites associated with rock art (both paintings and engravings), and shallow occupation deposits. Colonial era sites are relatively common and often well preserved.

One minor occurrence was:

QRS 234/615 S22.88937 E17.56039: Historic/modern farm cemetery >50 graves, fenced, 30m east of road centreline.

The Significance and Vulnerability of archaeological sites within the transmission line buffer zone is set out in Table 1, below.

Table 1: Archaeological and related sites within the proposed Kokerboom - Auas transmission line corridor

Site number	Significance	Vulnerability	Sensitivity
Nama Karoo Basin			
QRS 234/604	4	3	12 (Med)
QRS 234/605	4	3	12 (Med)
QRS 234/606	1	1	1 (Low)
QRS 234/607	1	1	1 (Low)
QRS 234/608	1	1	1 (Low)
QRS 234/609	1	1	1 (Low)
Weissrand Plateau			
QRS 234/611	1	1	1 (Low)
QRS 234/612	1	1	1 (Low)
Kalahari Sandveld			
QRS 234/613	1	1	1 (Low)
QRS 234/614	1	1	1 (Low)
Khomas Hochland			
QRS 234/615	4	1	4 (Med)

3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

NamPower proposes to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 457 km. There are an existing 400 kV and a 220 kV transmission line connecting the two substations but these follow a different route. The final transmission line servitude will be 44 m width, with 12 m of that being cleared for an access track.

The proposed transmission line corridor alignment runs south from the Kokerboom Substation and then parallel to the 220 kV transmission power line from Kalkrand southwards. It will exit the existing Kokerboom Substation in a southerly direction and enter the existing Auas Substation from the north.

The proposed transmission power line traverses 3 regions, namely the Khomas, Hardap and //Karas Regions. There are six (6) potentially affected constituencies, the Windhoek Rural, Mariental Rural, Rehoboth Rural, Gibeon, Berseba and Keetmanshoop Rural constituencies.

The infrastructure proposed includes a 400 kV transmission line conductor strung onto 45 m high steel pylons, of the Open-V or the Self-Supporting design, placed approximately 500 m apart. These pylons will be placed on a 10 m by 10 m concrete base. The line needs to be at least 100 m away from the 220 kV power line.

The proposed construction work to be carried out includes:

- Site establishment, including site demarcation and fencing (temporary and only where required), layout and establishment of the Contractor's Camp including ablution and cooking facilities (this will only be established if required by the appointed Contractor)
- Digging of holes for the concrete pylon base
- Casting of concrete platforms for the pylons
- Transportation of plant, machinery and equipment to site
- Transport of the conductor into position by means of a pulley system or by rolling large coils of conductor into position
- Hoisting and lifting of the pylons into position
- Stringing of the conductor and
- Construction of the access road.

The transmission power line will take approximately 24 months to construct, depending on whether one or more Contractors are appointed to undertake the work and/ or there are one or more working fronts.

Prior to construction, a final 'walkdown' of the proposed centreline of the transmission power line corridor alignment will be undertaken and the sites of each of the pylons finalised and demarcated. During final positioning of the pylons, sensitive features (e.g. plant habitats and archaeological sites) will be avoided.

An Environmental Management Plan (EMP) for the construction phase will be compiled. It will be included in the tender documentation and the Contract with the appointed Contractor(s). It will contain all the mitigation measures/ management actions proposed in this EIA process and will be included in draft format in the Assessment Report, which will be compiled in the next phase of this EIA.

NamPower has operated the existing 400 kV and 220 kV transmission power lines between the Kokerboom and Auas Substations for the past >15 years. The operation of the power line will be a continuation of the *status quo* operational and maintenance activities, namely:

- Site inspections, including Technical and Safety, Health, Environment and Wellness (SHEW)
- Power line housekeeping
- Vegetation management, including herbicide application and manual vegetation clearing
- Maintenance of the powerline and repair of the access roads

The above construction and operational activities formed the development 'proposal' (referred to as the proposed Project) as assessed in the EIA process.

3.1 Alternatives

A number of alternatives ('no-go', technology, methods of construction and operation, equipment, and mitigation measures) to the construction and operation of the transmission power line were considered by NamPower and assessed during the EIA process.

The 'no-go' alternative is not recommended given the importance of the Kokerboom to Auas transmission line in the supply of power to Namibia. The demand for power is continually increasing as a result of population expansion, diminishing power supply from Namibia's neighbouring countries, as well as residential, mining, agricultural and industrial development. The existing 400 kV and 220 kV power lines cannot cope with the expected power requirements into the future. A new line is currently predicted to be needed to come on line with the overall transmission line system within the next 6 to 10 years. Should the Kudu Gas Project come on line earlier than expected then the transmission power line will be required earlier.

Three alternative power line corridors were assessed during this Scoping Assessment. Each alternative was scoped and a new alternative put forward for assessment that avoided potential negative biophysical as well as socio-economic impacts. The power line corridor is 250 m either side of the centre line.

The technical specialists although involved in the scoping of the power line corridor alternatives only assessed the ‘favoured’ alternative in detail. The preferred corridor alignment avoided sensitive environmental features, most notably sensitive perennial pans and an avifauna hotspot and social infrastructure such as landing strips, recreational areas, homesteads, towns, villages etc.

In sourcing the specific equipment for the proposed transmission line project, NamPower will assess alternatives in terms of availability, efficiency, compatibility with the existing equipment, cost and environmental sustainability, before making a final decision.

Operational alternatives are limited as NamPower already has an operational protocol for the 400 kV and 220 kV power lines between the Kokerboom and Auas Substations which is working well. Operational procedures will be a continuation of the *status quo,* as new operational procedures are considered unnecessary by NamPower given that the current ones are tried and tested and considered effective, efficient and sustainable.

4 POTENTIAL IMPACTS

The potential impacts of the proposed development are estimated on the basis of the field survey data presented.

The proposed development may result in direct physical impacts on mid-Pleistocene to late Holocene archaeological sites, early colonial sites and grave sites, as well as visual impact on the physical setting of the sites. The proposed development may also affect Palaeozoic fossil outcrops

4.1 Identification of Potential Impacts

NamPower identified the transmission line corridor alignment in consultation with the directly affected land owners, key stakeholders, and with input from the environmental consultants, relevant specialists and registered Interested and Affected Parties. The screening of corridor alignments and the development of a "preferred" alignment has already served to avoid and reduce potential negative impacts of the proposed project on archaeological sites.

The potential impacts on the archaeology and heritage resources identified for the construction and operational phases, as well as cumulative impacts, are discussed below:

4.1.1 Construction Phase

Disturbance or destruction of palaeontological and archaeological remains; negative impact on the physical landscape setting of such sites.

4.1.2 Operational Phase

Inadvertent damage to palaeontological and archaeological sites within the project servitude during normal operational activities, i.e. line maintenance; unregulated public use of servitude tracks resulting in damage to palaeontological and archaeological sites.

4.1.3 Cumulative impacts

Encroachment of servitude tracks on palaeontological and archaeological sites and possible accelerated soil erosion as a result of water run-off from compacted track surfaces.

4.1.4 Sensitive archaeological sites

The following sensitive archaeological sites were identified within the proposed Kokerboom to Auas transmission line corridor:

- QRS 243/604 S26.14268 E18.30721: Pre-colonial burial cairn 2m diameter, slightly dispersed, on stream terrace.
- QRS 243/605 S26.14444 E18.30861: Colonial era grave, 2.2m long, unmarked, on stream terrace.
- QRS 234/615 S22.88937 E17.56039: Historic/modern farm cemetery >50 graves, fenced, 30m east of road centreline. Confirmation is required as to whether this is the site referred to by the I&AP Comments and Response Report (4th August 2016), Item B035, Mr Romeis. The site is an established cemetery and unlikely to be affected by the proposed Kokerboom to Auas transmission line corridor.

4.1.5 Impact rating tables

(a) Construction Phase

The table below outlines predicted environmental impacts on archaeology and heritage resources, both with and without mitigation, during the construction phase.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 1: e.g. Direct impact:										
Impact Description: Direct impact on sensitive sites by construction vehicles										
Without Mitigation	As described	Local	Permanent	Low	nil	High	Loss of site	Highly Probable	High	High
Mitigation Description: Supervision, barrier fencing, deviation of servitude track, excavation if necessary Indicate if mitigation is possible. Mitigation measures as described, alternatively excavation and removal of the sites.										
With Mitigation	As described	Local	Permanent	Negligible	nil	Low	Removal of site	Probable	High	High
Cumulative Impact: It is anticipated that this impact would be immediate if no mitigation measures are adopted Description of impact and significance: The risk of impact is high as is the significance of the sites that would be lost as a consequence										

(b) Operational phase

The table below outlines predicted environmental impacts on archaeology and heritage resources, both with and without mitigation, during the operational phase.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 1: e.g. Soil erosion:										
Impact Description: Gully erosion affecting sensitive sites as a result of mechanical clearing and use of servitude tracks										
Without Mitigation	-	Local	Permanent	Medium to high	nil	High	Irreversible damage	Probable	High	High
Mitigation Description: Deviation of servitude track as described, construction of erosion berms and placement of gabions Indicate if mitigation is possible. Deviation of servitude track as described										
With Mitigation	-	Local	Preventable	Low	Medium	Medium	Alters physical setting	Probable	Medium	High
Cumulative Impact: Gully erosion will require interventions such as rock berms and gabions which will alter and degrade the physical setting of the sites. Description of impact and significance: Visual disruption										

4.2 Mitigation of Impacts

The basic principle of archaeological mitigation is to guide development to either avoid potential negative impacts or achieve the least possible negative impact on protected archaeological resources. Mitigation measures are designed to reduce the consequence or probability of an impact, or to reduce both consequence and probability.

Thus, field survey, documentation and evaluation of archaeological sensitivity are indispensable precursors of mitigation. The field survey results not only inform the process towards mitigation but also serve as a basic record of the archaeology in the event of inadvertent impact. Where impact is an unavoidable consequence of development full archaeological mitigation is required to comply with national laws, international guidelines and professional best practice standards. This may involve higher level documentation, collection and removal of archaeological remains and excavation of sites such as graves. The decision as to the most appropriate mitigation course is taken by the NHC in light of recommendations set out in a project mitigation proposal. Mitigation measures aim to be practicable with measurable targets, as far as possible.

Archaeological mitigation may also include the demarcation of archaeological “no-go” areas, the proclamation of archaeological Conservation Areas under the National Heritage Act, and negotiation of substantial changes in the project footprint. It is an important principle that damage to archaeological sites is irreparable and must therefore be avoided if at all possible. It is a further principle, also held in the National Heritage Act, that both the archaeological site and its physical/visual setting are protected under the law.

The transmission line route has already been altered to avoid potential environmental impacts. NamPower identified suitable routing options for the transmission line in consultation with a range of personnel from NamPower, and with input from the environmental consultants and relevant specialists. The realignment has already served to **avoid** and **reduce** potential negative impacts of the proposed project on archaeological and other environmentally sensitive areas/ receptors.

Mitigation will strive to achieve the following:

- **Rectification**: impact is mitigated after it has occurred e.g. rehabilitation of areas disturbed by construction
- **Compensation**: providing a substitute resource for a resource that has been lost because of the project e.g. “ offsets”
- **No action** (least preferred) and
- **Enhancement**: establish optimisation measures that will enhance the benefits of the positive impacts.

Appropriate mitigation measures for archaeological and related sites within the Kokerboom - Auas transmission line corridor are as follows: These are to be incorporated as a single set of guideline measures in the project EMP and applied as necessary in the construction and operational phases of the project.

1. The location details of sensitive sites should be incorporated within the project GIS and EMPs for the operation and construction phases.
2. Sensitive sites should be cordoned off during the construction phase, using steel posts (fence droppers) and high visibility barrier mesh. All of this material should be removed following construction to reduce visibility of the sites.
3. Sensitive sites should be verified and marked during the “walkdown” of the final proposed centreline of the transmission line by a professional archaeologist.
4. Archaeological aspects should be captured with the Form (‘agreement’) between the landowner and NamPower before the start of construction.
5. Spacing of pylons should observe a minimum distance of 50 m on either side of each sensitive site.
6. The servitude track should not approach within 50 m of any sensitive site and should be deviated accordingly.
7. The track used during construction and stringing of the power line should be rehabilitated within 50 m on either side of each sensitive site.
8. The track used during construction should not be mechanically cleared within 50 m of each sensitive site so as to avoid future soil erosion.
9. Demarcation of the sensitive sites and the servitude track should be supervised by an appropriately qualified and experienced environmental officer.
10. All induction and on-going training should incorporate aspects regarding what action should be taken should archaeological remains and/ or graves be located, as well as the contents of the specific specifications that relate to sensitive archaeological sites.
11. In the case of the pre-colonial burial cairns, these features will have to be excavated and removed if the mitigation measures listed here are not feasible to implement. The excavation should be carried out under NHC Council issued permit, and by an appropriately qualified archaeologist.

4.3 Conclusions and Recommendations

The Archaeological Assessment study presented here is based on a field survey of the proposed Kokerboom-Auas transmission line buffer zone. No previous archaeological survey or assessment had been carried out in the area to be directly affected by the transmission line. The present survey is based on foot transects of 25 archaeological survey quadrats within the buffer zone, augmented by reconnaissance of surrounding terrain in order to gain a reliable impression of the local archaeological context. The results may be considered an adequate reflection of archaeological and related sites in the project area.

The project area is considered to be of generally low and medium significance and vulnerability, both to inadvertent disturbance during the project construction phase, and to accelerated soil erosion associated with surface disturbance resulting from the establishment of a servitude track to be used during the operational phase. Mitigation options – assuming that deviation of the transmission line route is not feasible – include the use of minimum buffer zones for the positioning of pylons, buffer zones for deviations in the servitude track, the use of high visibility barrier mesh around specific sites during construction, and the rehabilitation of the construction phase track used during the stringing of the transmission line.

It is recommended that the generic Archaeological Chance Finds Procedure presented in Appendix 1 is adopted as part of the project EMP and that both the client and contractors are informed regarding the legal protection of archaeological sites in terms of the National Heritage Act.

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APPENDIX 1: Generic Archaeological Chance Finds Procedure

Areas of proposed infrastructure development have been subject to a heritage survey and assessment at the planning stage. This survey was based on surface indications alone, and it is therefore possible that sites or items of heritage significance will be found in the course of development work. Personnel and contractor heritage induction is intended to sensitize people so that they may recognize heritage “chance finds” in the course of their work. The procedure set out here covers the reporting and management of such finds.

The “chance finds” procedure covers the actions to be taken from the discovery of a heritage site or item, to its investigation and assessment by a trained archaeologist or other appropriately qualified person. The “chance finds” procedure is intended to ensure compliance with the relevant provisions of the National Heritage Act (27 of 2004), especially Section 55 (4): *“ a person who discovers any archaeological …. object ……must as soon as practicable report the discovery to the Council”.* The procedure of reporting set out below must be observed so that heritage remains reported to the National Heritage Council (NHC) are correctly identified in the field.

Please note that the Chance Finds Procedure is NOT a substitute for archaeological assessment. Both Namibian and international standards (e.g. International Finance Corporation (IFC) Guidance Note and IFC Performance Standard on Heritage, 2012) require professional archaeological assessment. The Chance Finds Procedure is intended to assist the developer in following the right course of action when archaeological remains are encountered such as during earthmoving or dense bush-clearing operations.

RESPONSIBILITIES
Contractor and/ or Operator: To exercise due caution if archaeological remains are found
Foreman: To secure site and advise management timeously
Superintendent: To determine safe working boundary and request inspection
Archaeologist: To inspect, identify, advise management, and recover remains

PROCEDURE
<u>Action by person (operator) identifying archaeological or heritage material</u>
a) If operating machinery or equipment: **stop work**
b) Identify the site with flag tape
c) Determine Global Positioning System (GPS) position if possible
d) Report findings to the Foreman

<u>Action by Foreman</u>
a) Report findings, site location and actions taken to superintendent
b) Cease any works in immediate vicinity

<u>Action by Superintendent</u>
a) Visit site and determine whether work can proceed without damage to findings
b) Determine and mark exclusion boundary
c) Site location and details to be added to AH GIS for field confirmation by archaeologist

<u>Action by professional Archaeologist</u>
a) Inspect site and confirm addition to AH GIS

b) Advise NHC and request written permission to remove findings from work area
c) Recovery, packaging and labelling of findings for transfer to National Museum

<u>In the event of discovering human remains</u>
a) Actions as above
b) Field inspection by Archaeologist to confirm that remains are human
c) Advise and liaise with the NHC and Police
d) Recovery of remains and removal to National Museum or National Forensic Laboratory, as directed.

NamPower

Powering the Nation and beyond

PROPOSED KOKERBOOM – AUAS 400 KV TRANSMISSION LINE

ENVIRONMENTAL IMPACT ASSESSMENT

Vegetation Assessment Report
For Environmental Impact Assessment Report

Coleen Mannheimer (M.Sc.)
P.O. Box 193
Windhoek
Namibia

July 2016

Coleen Mannheimer Botanical Consulting

1 July 2016

DECLARATION OF INDEPENDENCE

I, Coleen Anne Mannheimer, as duly authorised representative of Coleen Mannheimer Botanical Consulting confirm my independence (as well as that of Coleen Mannheimer Botanical Consulting) as a specialist and declare that neither I nor Coleen Mannheimer Botanical Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Lithon Project Consultants (Pty) Ltd was appointed to managed the Environmental Impact Assessment (EIA) process or Ms. Jaana-Maria Ball was appointed as Environmental Assessment Practitioner in terms of the Environmental Management Act, 2007 (Act No. 7 of 2007) and the Environmental Impact Assessment Regulations, 2012, other than fair remuneration for worked performed, specifically in connection with the EIA process for the proposed Kokerboom to Auas 400 kV transmission line. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – within the limitations as are described in my attached report.

My expertise and experience is as follows:

I hold an MSc in Plant Taxonomy from Rhodes University. Twenty years of experience involving several years as curator of the National Herbarium of Namibia and contributions to knowledge of the Namibian flora, including the Tree Atlas of Namibia, the Red Data Book on Namibian Plants, the field guides to wildflowers of the southern Namib and the central Highlands of Namibia, the photographic fieldguide to the trees and shrubs of Namibia, as well as extensive experience in collection and identification of indigenous plants have equipped me to assess threats to the national flora and suggest mitigation and monitoring measures where feasible.

I have been involved in specialist vegetation studies for Environmental Impact Assessments of, *inter alia*, the Kudugas power station and power lines, the Kokerboom and Omburu power lines, the Ruacana-Oshivelo power line, Otjikoto Gold Mine, site and linear infrastructure for several uranium and copper mines and several MTC towers, as well as plant rescue missions for Skorpion Zinc Mine, Environmental Sensitivity zoning exercises for the Aus and Oranjemund townlands and a Biodiversity Survey of the Windhoek Townlands.

Coleen Mannheimer.

Coleen Anne Mannheimer

Title / Position: Botanist

Qualification(s): M. Sc. Plant taxonomy, Rhodes University

Prof. Membership: EAPAN Member number 135

Experience: 20 years

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EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

VEGETATION ASSESSMENT REPORT FOR INPUT INTO THE IMPACT ASSESSMENT REPORT

EXECUTIVE SUMMARY

A specialist desktop vegetation study was undertaken to identify potential impacts on the Namibian flora of a proposed new single-circuit 400 kV transmission power line between the Kokerboom Substation, located north-east of Keetmanshoop in the Karas Region, to the Auas Substation, located east of Windhoek in the Khomas Region of Namibia. The length of the proposed NamPower powerline is approximately 500 km. There are two existing transmission lines connecting the two substations, a 400 kV and a 220 kV line. The pylon height will be approximately 45 m and the distance between pylons approximately 500 m.

The purpose of the proposed Project is to strengthen the overall transmission network within Namibia. It is proposed to be constructed in approximately 10 years' time (i.e. 2026), and possibly earlier if the Kudu Gas Project comes on line earlier than expected. Without upgrades to the transmission line network electricity supply in Namibia will in future become constrained, and as a result potentially restrict development and negatively impact quality of life in the country as a whole.

This independent Vegetation Assessment forms part of the full Environmental Impact Assessment (EIA) process undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966) and the EIA Regulations, 2012.

No fatal flaws were identified. The proposed transmission line corridor route was found to traverse three distinct vegetation zones of differing sensitivity. The northern section of the route traverses the Highland Savanna, a zone of high diversity and endemism, but most of the species of high concern are concentrated on slopes of mountains and koppies, which are largely avoided by the route. Given careful planning and placement of pylon sites and mitigation of collateral damage to vegetation specifically, damage to the flora could be very limited due to the linear nature of the proposed facility.

However, the present route travels over areas where there are dense stands of *Acacia erioloba*, including many of appreciable size and age. Because this is a slow-growing, protected species facing increasing cumulative impacts country-wide, negative impacts on this species will have to be strictly constrained and regulated.

EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

VEGETATION ASSESSMENT REPORT FOR INPUT INTO IMPACT ASSESSMENT REPORT

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GLOSSARY OF TERMS, DEFINITIONS AND ABBREVIATIONS

Affected Environment	Those parts of the socio-economic and biophysical environment impacted on by development
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternatives sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called "no action" alternative may also require investigation in certain circumstances.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that are relevant to the decision.
Construction Activity	A construction activity is any action taken by the Contractor, his subcontractors, suppliers or personnel during the construction process.
Contractor	That main organisation appointed by the Developer, through the Project Manager (PM), to undertake construction activities on the site.
DEA	Directorate of Environmental Affairs
Developer (or Project Proponent)	NamPower
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer: The ECO monitors compliance with the EMP during the construction phase and advises the Project Manager on environmental matters relating to construction.
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report; A report describing the process of examining the environmental effects of a development proposal, the expected impacts and the proposed mitigation measures.
EMP	Environmental Management Plan: The EMP for the project sets out general instructions that will be included in a contract document for the construction phase of the project. The EMP will ensure the construction activities are undertaken and managed in an environmentally sound and responsible manner.

Environment	Means the surroundings within which humans exist and that are made up of: a. The land, water and atmosphere of the earth. b. Micro-organisms, plant and animal life. c. Any part or combination of a) and b) and the interrelationships among and between them. d. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.
Environmental Specifications (ES)	Instructions and guidelines for specific construction activities designed to help prevent, reduce and/or control the potential environmental implications of these construction activities.
I&AP(s)	Interested and Affected Party(s)
MET	Ministry of Environment and Tourism
Method Statement	A written submission by the Contractor to the Project Manager in response to the Specification setting out the plant, materials, labour, timing and method the Contractor proposes using to carry out an activity. The Method Statement shall cover applicable details with regard to: • Construction procedures. • Materials and equipment to be used. • Getting the equipment to and from site. • How the equipment/material will be moved while on site. • How and where material will be stored. • The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or solid material that may occur. • Timing and location of activities. • Compliance/ non-compliance with the Specifications. • Any other information deemed necessary by the Project Manager.
Project	This refers to all construction activities associated with the proposed activities.
PM	Project Manager: Appointed firm responsible for overall management of the construction phase of the project including the management of all contractors.
PPE	Personal Protective Equipment
Rehabilitation	Rehabilitation is defined as the return of a disturbed area, feature or structure to a state that approximates to the state (where possible) that it was before disruption, or to an improved state.

SHE	Safety, Health and Environment
Solid Waste	Means all solid waste, including construction debris, chemical waste, excess cement/concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

1 INTRODUCTION

1.1 Background

This independent Vegetation Assessment forms part of the full Environmental Impact Assessment (EIA) process (i.e. Screening, Scoping and Impact Assessment phases) undertaken and which the documentation emanating therefrom will be submitted to the competent authority, The Directorate of Environmental Affairs: Ministry of Environment and Tourism (MET-DEA), for decision-making. The EIA is being undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966) and the EIA Regulations, 2012.

NamPower proposes to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km. The Substations will not be expanded. There are two existing transmission lines connecting the two substations, a 400 kV and a 220 kV line. This infrastructure alone is considered inadequate to meet the future needs of the transmission line system. The pylon height will be approximately 40 m and the distance between pylons approximately 500 m. The purpose of the proposed Project is to strengthen the overall transmission network within Namibia. It is proposed to be constructed in approximately 10 years' time (i.e. 2026), and possibly earlier if the Kudu Gas Project comes on line earlier than expected. Without upgrades to the transmission line network electricity supply in Namibia will in future become constrained, and as a result restrict development (mining, industrial and residential) and negatively impact quality of life in the country as a whole.

The EIA assessed the environmental acceptability of constructing, operating and maintaining a power line in the area with a length of approximately 500 km and width of 500 m (250 m from the centre line) and a final servitude of 80 m width, with 12 m of that being cleared for an access track. The access track will be used to bring in construction materials, as well as being used to access the power line and its associated pylons for maintenance purposes, throughout the infrastructure's life span. Emphasis was placed on the optimisation of route as well as cumulative impacts of multiple power lines within the study area.

This specialist Vegetation Assessment considers the potential impacts of constructing and operating (including maintaining) the proposed transmission line and its associated infrastructure (for example access track) on the vegetation within the 500 km and 500 m wide transmission line corridor.

This Vegetation Assessment Report has been compiled within the Impact Assessment phase of the EIA. The main objective of the Impact Assessment phase of the EIA is to identify all the potential significant impacts and recommend mitigating measures to eliminate or reduce the effect of the negative impacts, and enhance the effect of the positive impacts.

1.2 Study Objectives

This Vegetation Assessment's main objective was to identify all the significant impacts of the proposed Project on the vegetation and sensitive habitats, as well as cumulative impacts. A further objective is to suggest mitigation measures and management actions to either avoid or reduce the potential negative impacts to an acceptable level or enhance any potential positive impacts.

1.3 Report Content

The content of the Vegetation Assessment Report is consistent with the requirements for specialist studies as set out in the EIA Regulations, 2012, and the Procedures and Guidelines for Environmental Impact Assessment EIA) and Environmental Management Plans (EMP) issued by the MET- DEA in 2008, and in summary contains:

- Details and experience of the person who undertook the assessment and prepared the Report.
- Description of the anticipated impacts, and the methods and procedures for mitigating these identified impacts.
- Description of the proposed activity and its alternatives
- Description of the proposed study area and site
- Description of the need and desirability of the proposed project,
- Policy, legal and administrative/ institutional framework
- Methodology used as well as the assumptions and limitations of the study
- Description and assessment of potential environmental impacts, including cumulative impacts
- Recommendations to avoid and/ or reduce potential negative impacts and enhance potential positive impacts and
- References.

1.4 Details of the Principal Parties

The Project Proponent/ Applicant is NamPower a state utility whose mandate is to produce, transmit and distribute power to its clients, the users of the power.

The EIA process is being managed by Lithon Project Consultants (Pty) Ltd and the appointed EAP is Ms. Jaana-Maria Ball who is a registered Reviewer and Lead Consultant with the Environmental Assessment Practitioners Association of Namibia (EAPAN). She prepared all the documentation emanating from this process.

This independent Vegetation Assessment was undertaken by Ms Coleen Mannheimer of Coleen Mannheimer Botanical Consulting to inform the assessment of the potential impacts arising from this proposed development. Ms. Mannheimer's contact details, expertise and experience as well as a Declaration of Independence by these individuals is found on Pages i and ii.

1.4.1 Scope of Work

The scope of work for the Vegetation Assessment is:

- By means of a review of relevant information, identify the plant species and habitats that occur or are thought to occur along the route, with emphasis on those that are valuable from a biodiversity and/or ecological point of view.
- Identify areas with sensitive vegetation (species that are endemic, protected, or otherwise of high conservation value) along the proposed route and, where pertinent, explain the value of each site.
- Identify relevant national and international guidelines, protocols, legal and permit requirements (if any) to ensure compliance with such.
- Identify any potential impacts of the proposed project on the vegetation, including cumulative impacts
- Describe any mitigation actions and/ or management actions required to avoid or minimise the negative impact of the project on the vegetation, and enhance positive impacts.

1.5 Study Approach

1.5.1 Methodology

The Vegetation Assessment was undertaken from July 2015 to 6 August 2015 and 25 June 2016 to 1 July 2016 as follows:

- Review of literature sources (e.g. Bruyns, P.V. 2014, Craven 2002, Craven & Vorster 2006, Loots 2005, Golding 2002) and known plant species distribution according to the National Herbarium Database (BRAHMS) as well as species and area conservation status, to identify plant species of high conservation concern and where they might be concentrated.
- Review distribution and habitat of all species of concern known to occur in the vicinity of the proposed route.
- Review of proposed route and revised route on Google Earth to identify habitat of potential concern.
- Fieldwork.
- Preparation of the Vegetation Assessment Report, including input into the Environmental Management Plan.

Nomenclature largely follows Klaassen & Kwembeya (eds) 2013.

1.5.2 Assumptions and Limitations

The assumptions for the Vegetation Assessment are:

- All assessments of sensitivity are made in the context of the nature of this proposed project, which is narrow and linear and which, to some extent, runs alongside an existing power line servitude. These sensitivities would not necessarily apply to the greater area if the impact was broader or more extensive.

The limitations of the Vegetation Assessment are:

- This was largely a desktop assessment and limited fieldwork was undertaken.

1.6 Policy, Legal and Administrative Framework

This specialist study is focused on sound environmental management practices and is based on national and international best practices, and relevant legislation, policies and guidelines. This includes the following:

- The Constitution of the Republic of Namibia, of 1990
- Nature Conservation Ordinance No. 4 of 1975 and amendments
- Nature Conservation Amendment Act, 5 of 1996
- Forest Act, 12 of 2001, including subsequent amendments and regulations
- Environmental Assessment Policy for Sustainable Development and Environmental Conservation 1995
- Convention on Biological Diversity, 1992
- Convention to Combat Desertification, 1994

The list of applicable legislation provided above is intended to serve as a guideline only and is neither exhaustive nor inclusive.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

2.1 The Receiving Environment

2.1.1 Land use

The proposed power line corridor alignment traverses land presently use for stock-farming.

2.1.2 Vegetation

The section of the route from the Kokerboom substation to just north of Mariental (Section A) traverses the Dwarf Shrub Savanna (Giess 1998), which forms part of the Nama-Karoo Biome, for approximately 300 km, to approximately 15 km north of Kalkrand. From there it continues through the Mixed Tree and Shrub Savanna of the Southern Kalahari for about 55 km (Section B), until it reaches the foothills of the Highland Savanna, which it traverses for about 100 km before reaching the Auas substation (Section C). Figures 1 to 4 depict these three sections.

(a) Section A (Dwarf Shrub Savanna)

This zone is characterised by shallow, stony soils that carry a predominance of grasses and Karoo shrubs (Giess 1998). Sizeable woody species known from that zone are largely confined to drainage lines and the verges of seasonally wet depressions and pans, including protected species such as *Acacia erioloba, Ziziphus mucronata, Searsia lancea* and *Euclea pseudebenus.* Protected woody species of a more scattered distribution in the zone include *Aloe dichotoma, Albizia anthelmintica, Boscia albitrunca* and *Maerua schinzii.* Although 18 endemic and 11 protected species are recorded for the general area, no species of high conservation concern (range or habitat restricted endemic or protected species) are presently known or expected to occur in any meaningful numbers along the route in this vegetation zone. Those recorded there are all reasonably widespread and very unlikely to be threatened by this proposed project. However, *Aloe dichotoma* (Kokerboom, Quiver tree) does occasionally form dense stands which would make them of concern in that instance.

Sensitivity: Low

(b) Section B (Mixed Tree and Shrub Savanna)

This is largely an area of red sandy dunes generally slanting from north-west to south-east interspersed with harder inter-dune valleys with stonier, harder substrates. Harder, more compact soils are also characteristic of the river banks, and many small pans (often with clay/calcrete substrates) are scattered throughout the zone. Although only one wide-ranging endemic herb is recorded from the vicinity of the route, several protected trees species are common in this vegetation type, including *Acacia erioloba, Albizia anthelmintica, Boscia albitrunca* and *Maerua schinzii. Ziziphus* *mucronata* is also typical along rivers and drainage lines. The route east of Tsumis between approximately 23° 42' 14" s and 23° 51' 34" S (indicated in red on Figure 3) are of particular concern regarding dense stands of *Acacia erioloba* and dune areas along this section also support large specimens of *Acacia erioloba* and *Albizia anthelmintica* that are valued by farmers for the shade and the forage they offer to stock animals. This is valuable woodland that raises the relative sensitivity of this zone.

Sensitivity: Medium to High

(c) Section C (Highland Savanna)

This is one of the zones of highest plant diversity and endemism in Namibia. It is a mixed tree and shrub savanna that includes many protected tree species, such as *Acacia erioloba, Aloe littoralis, Boscia albitrunca, Albizia anthelmintica, Maerua schinzii* and *Erythrina decora* as well as those typical of drainage lines, ie: *Ziziphus mucronata* and *Searsia lancea*. Thirty six (36) endemic and 9 protected species have been recorded in the area around the route. Species of potential concern include the protected trees and a number of other protected and/or restricted range endemics (e.g. *Anacampseros filamentosa* subsp. *tomentosa, Aloe viridiflora*). With the exception of *Acacia erioloba*, which occurs in dense stands over much of this section, and other protected trees that occur as scattered individuals (e.g. *Boscia albitrunca, Albizia* anthelmintica), the species of highest concern occur entirely or mostly on high-lying slopes or at the edges of pans, which are not affected to any large extent by this project.

Sensitivity: High

An annotated list of species of potential concern is presented in Appendix 1 to give an overview of their extent of occurrence, conservation status, known occurrence in the vicinity of the proposed route and notes on action needed regarding this proposed project. Those requiring mitigation are summarised in Table 1. No Red Data species belonging to any threatened category were listed.

Figure 1: Overview of vegetation sections within the proposed power line corridor route alignment.

(Note the proposed centre line of the power line corridor is indicated by a white line)

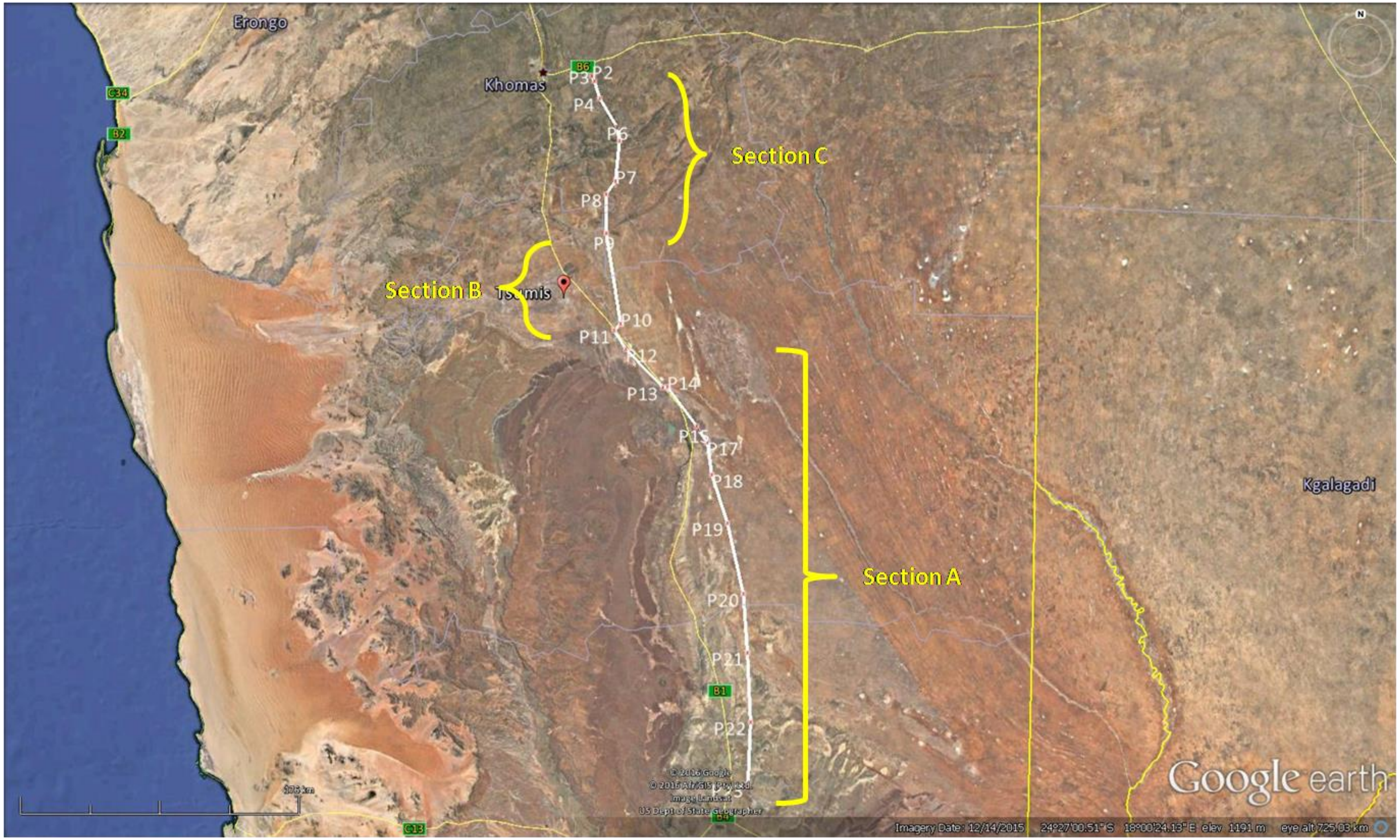

Figure 2: Section A traverses Dwarf Shrub Savanna vegetation.

(Note the proposed centre line of the power line corridor is indicated by a white line)

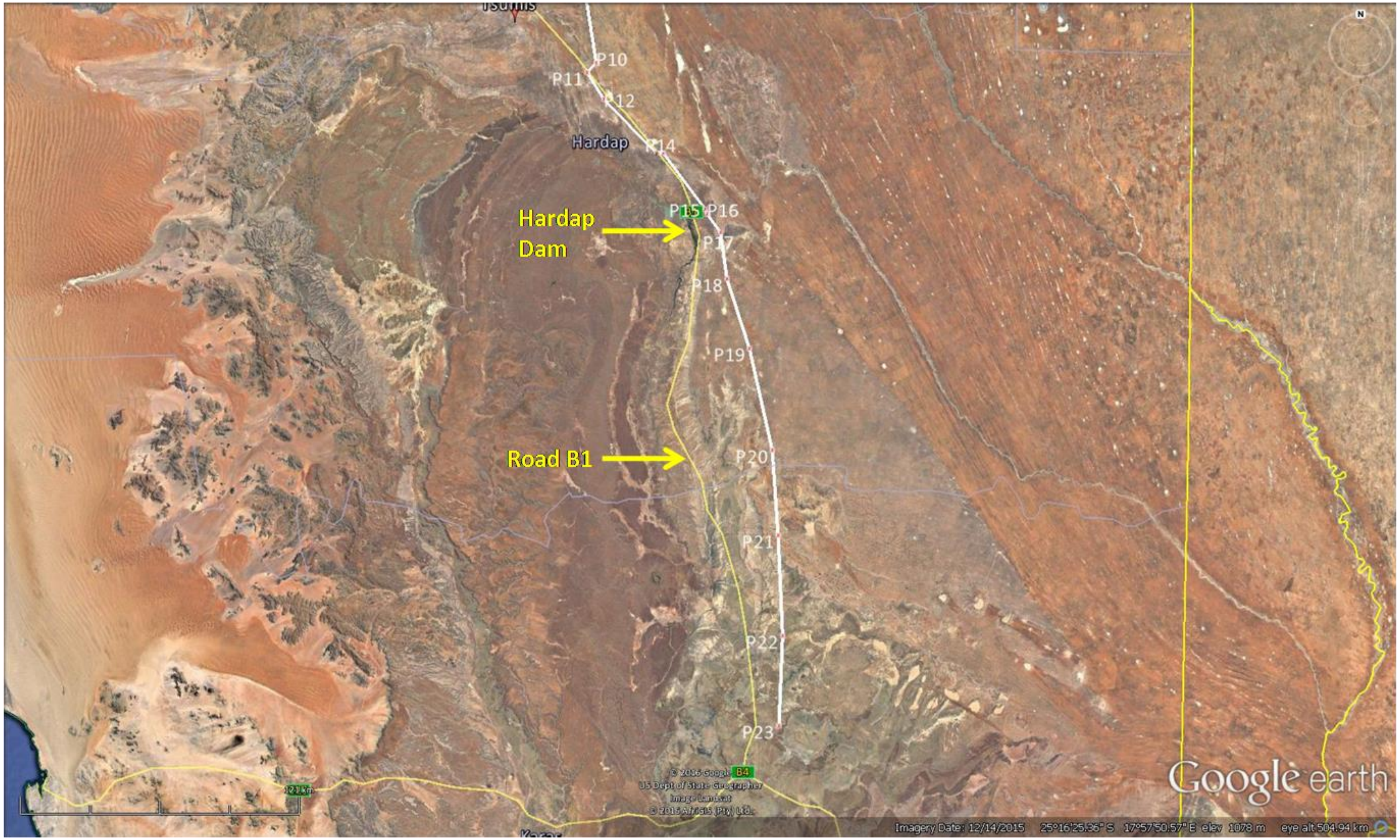

Figure 3: Section B traverses a mixed tree and shrub savanna on an area of red sandy dunes interspersed by gravelly valleys.

(Note the proposed centre line of the power line corridor is indicated by a white line)

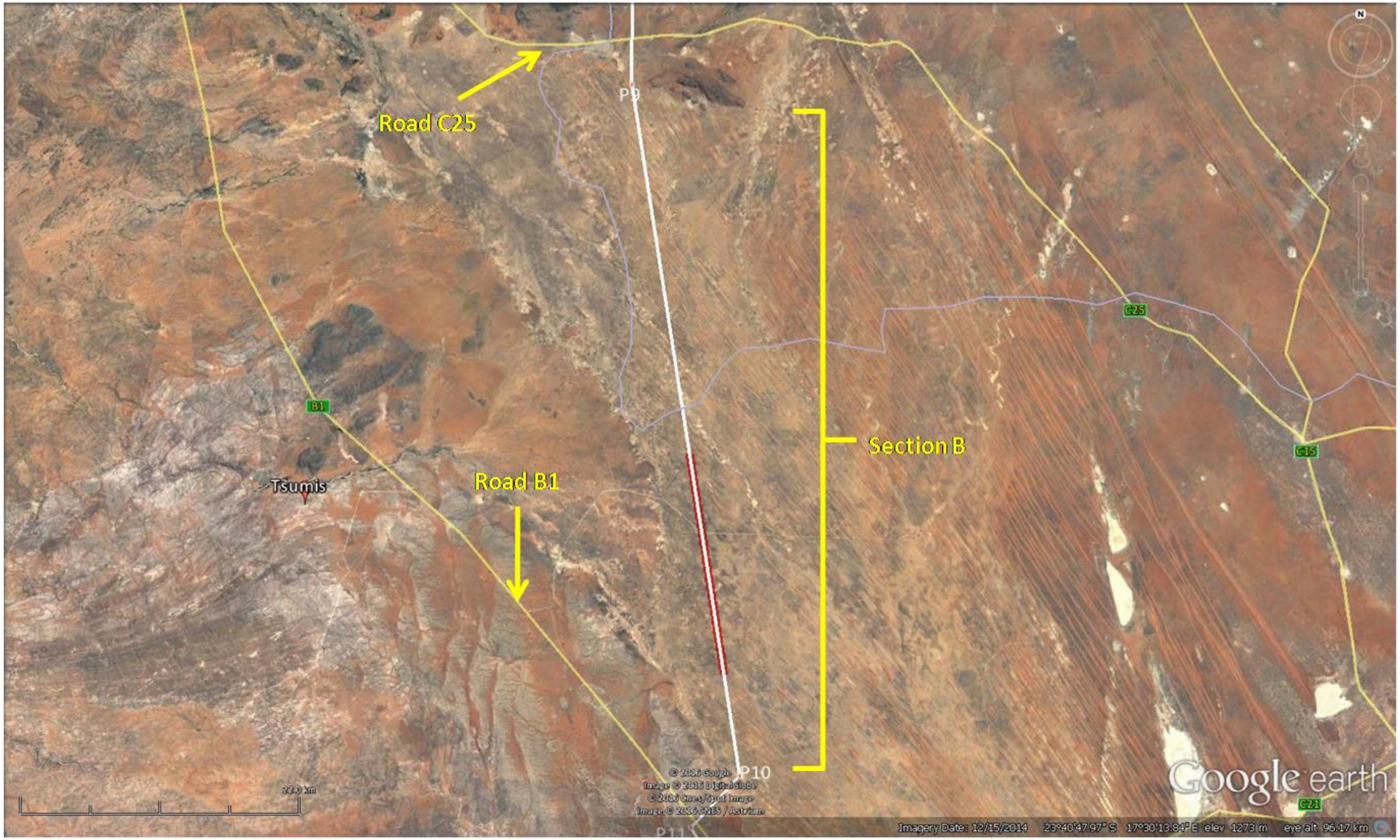

Figure 4: Section C traverses the Highland Savanna, an area of high diversity and endemism.

(Note the proposed centre line of the power line corridor is indicated by a white line)

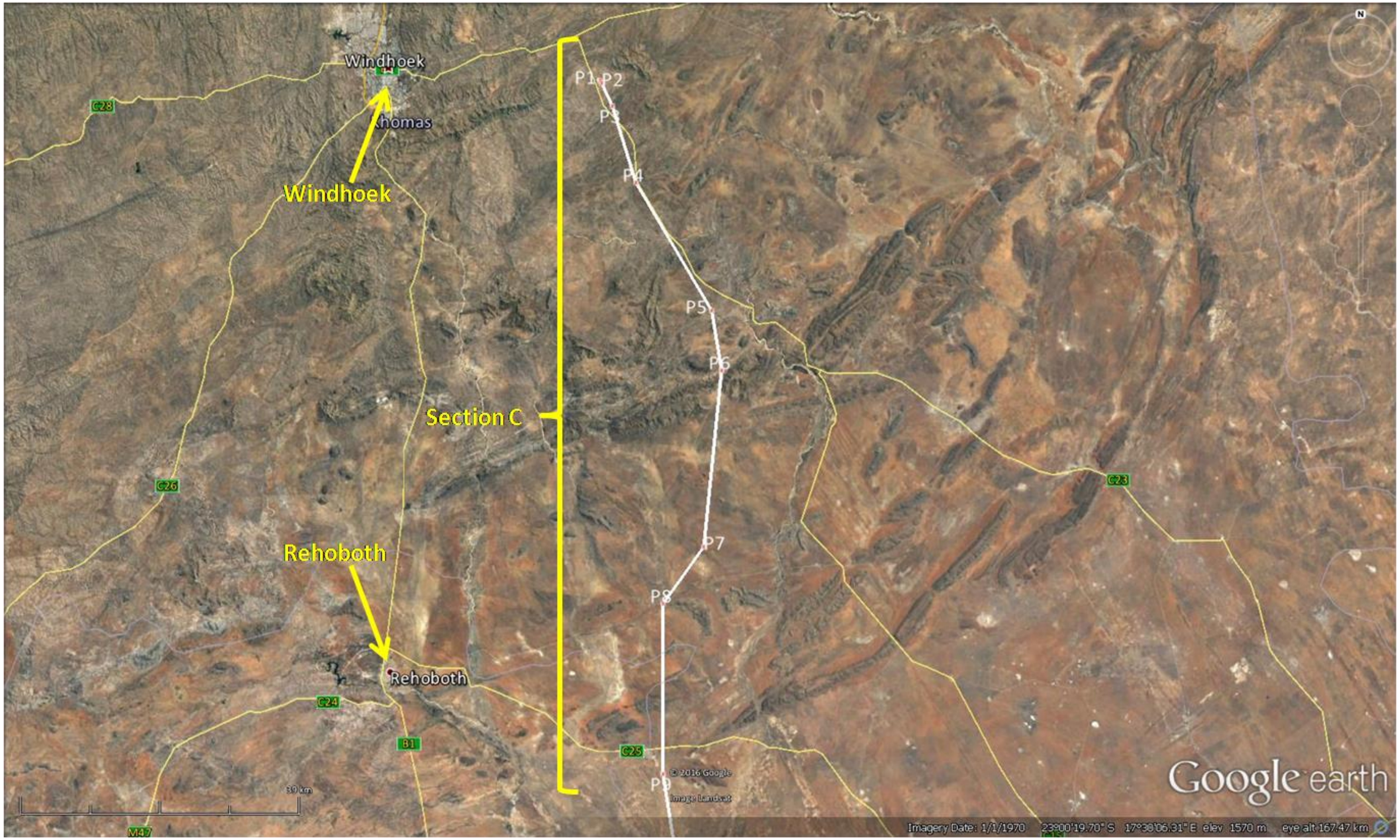

Table 1: Species assessed that require mitigation within the proposed power line corridor.

Species	Conservation status	Range in Namibia	Habitat if restricted	Occurrence in vicinity of proposed route if of possible concern	Notes
Acacia erioloba	Protected	Widespread		Dense populations near Tsumis as well as scattered from just south of bend point 4 to the Hohewarte area, as well as in riparian areas alongside drainage lines and on dune areas.	
Albizia anthelmintica	Protected	Widespread			
Aloe dichotoma	Protected	Widespread, sometimes in dense stands			
Aloe littoralis	Protected	Widespread, sometimes in dense stands			
Boscia albitrunca	Protected	Widespread			
Cyperus rehmii	Endemic	Known distribution highly restricted but almost certainly undercollected	Pans, seasonally wet areas	Farm Binsenheim/ Rietfontein	Unlikely to be affected, but can mitigate
Euclea pseudebenus	Protected	Widespread			
Maerua schinzii	Protected	Widespread			
Ziziphus mucronata	Protected	Widespread			

2.1.3 Critical Biodiversity Areas

Areas along the route east of Tsumis, as well as the southern parts of section C and the portion south and north of bend point 4 carry dense populations of *Acacia* *erioloba.* However, there are scattered densities of this species over much of the route in sections B and C. This species, and other protected species, such as *Albizia anthelmintica*, often favour dune areas. It is thus virtually impossible to define a “critical” area regarding these species without including most of sections B and C.

Slopes of koppies and mountains in the Highland Savanna (Section C) carry numerous species of concern and should be avoided as far as possible. At present this habitat is almost untouched by the proposed route.

Pan verges and banks of rivers and drainage lines are known to harbour higher than average numbers and sizes of protected woody species, as well as sedges such as *Cyperus rehmii.* Although it is very likely that this species is severely undercollected (most sedges are in Namibia), and may be more widespread and common than is presently known, the precautionary principle should be followed by avoiding this habitat for pylon sites. This will also favour the protected trees.

Dense stands of *Aloe dichotoma,* although rare, may be encountered in the southernmost extent of the route. They are very easy to identify and, if encountered, should be avoided for pylon placement. Service tracks should easily be able to circumvent the majority of individuals, which are usually sufficiently widely scattered.

3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

The proposed Project is a single-circuit 400 kV transmission power line from the Kokerboom to the Auas Substation, a distance of approximately 500 km. The final power line servitude will be 80 m wide with 12 m being cleared for an access track

The proposed corridor alignment runs south from the Kokerboom Substation and then parallel to the 220 kV transmission power line from Kalkrand southwards. It will enter the exit the existing Kokerboom Substation in a southerly direction and enter the existing Auas Substation from the north.

The preferred transmission power line corridor alignment traverses 3 regions, namely the Khomas, Hardap and //Karas Regions. There are six (6) potentially affected constituencies, the Windhoek Rural, Mariental Rural, Rehoboth Rural, Gibeon, Berseba and Keetmanshoop Rural constituencies.

The infrastructure proposed includes a 400 kV transmission line conductor strung onto 45 m high steel pylons, of the Open-V or the Self-Supporting design, placed approximately 500 m apart. These pylons will be placed on a 10 m by 10 m concrete base. The line needs to be at least 100 m away from the 220 kV power line.

The proposed construction work to be carried out includes:

- Site establishment, including site demarcation and fencing (temporary and only where required), layout and establishment of the Contractor’s Camp including ablution and cooking facilities (this will only be established if required by the appointed Contractor)
- Digging of holes for the concrete pylon base
- Casting of concrete platforms for the pylons
- Transportation of plant, machinery and equipment to site
- Transport of the conductor into position by means of a pulley system or by rolling large coils of conductor into position
- Hoisting and lifting of the pylons into position
- Stringing of the conductor and
- Construction of the access road.

The transmission power line will take approximately 24 months to construct, depending on whether one or more Contractors are appointed to undertake the work and/ or there are one or more working fronts.

Prior to construction, a final ‘walkdown’ of the proposed centreline of the transmission power line corridor alignment will be undertaken and the sites of each of the pylons finalised and demarcated. During final positioning of the pylons, sensitive features (e.g. plant habitats and archaeological sites) will be avoided.

An Environmental Management Plan (EMP) for the construction phase will be compiled. It will be included in the tender documentation and the Contract with the appointed Contractor(s). It will contain all the mitigation measures/ management actions proposed in this EIA process and will be included in draft format in the Assessment Report, which will be compiled in the next phase of this EIA.

NamPower has operated the existing 400 kV and 220 kV transmission power lines between the Kokerboom and Auas Substations for the past > 15 years. The operation of the power line will be a continuation of the *status quo* operational and maintenance activities, namely:

- Site inspections, including Technical and Safety, Health, Environment and Wellness (SHEW)
- Power line housekeeping
- Vegetation management, including herbicide application and manual vegetation clearing
- Maintenance of the powerline and repair of the access roads

The above construction and operational activities formed the development 'proposal' (referred to as the proposed Project) as assessed in the EIA process.

3.1 Alternatives

A number of alternatives ('no-go', technology, methods of construction and operation, equipment, and mitigation measures) to the construction and operation of the transmission power line were considered by NamPower and assessed during the EIA process.

The 'no-go' alternative is not recommended given the importance of the Kokerboom to Auas 400 kV transmission line in the supply of power to Namibia. The demand for power is continually increasing as a result of population expansion, diminishing power supply from Namibia's neighbouring countries, as well as residential, mining, agricultural and industrial development. The existing 400 and 220 kV power lines cannot cope with the power requirements into the future. A new line is currently predicted to be needed to come on line with the overall transmission system within the next 6 to 10 years. Should the Kudu Gas Project come on line earlier than expected then the transmission power line will be required earlier.

Three alternative power line corridors were assessed during this Scoping Assessment. Each alternative was scoped and a new alternative put forward for assessment that avoided potential negative biophysical as well as socio-economic impacts. The favoured alternative is presented in the **Figure 5** overleaf.

The technical specialists although involved in the scoping of the power line corridor alternatives only assessed the 'favoured' alternative in detail. The preferred corridor alignment avoided sensitive environmental features, most notably sensitive perennial pans and an avifauna hotspot and social infrastructure such as landing strips, recreational areas, homesteads, towns, villages etc.

Mitigation and management alternatives were considered by the technical specialists when making suggestions to avoid/ reduce negative impacts.

In sourcing the specific equipment for the proposed transmission line project, NamPower will assess alternatives in terms of availability, efficiency, compatibility with the existing equipment, cost and environmental sustainability, before making a final decision.

Operational alternatives are limited as NamPower already has an operational protocol for the 400 kV and 220 kV power lines between the Kokerboom and Auas Substations which is working well. Operational procedures will be a continuation of the *status quo,* as new operational procedures are considered unnecessary by NamPower given that the current ones are tried and tested and considered effective, efficient and sustainable.

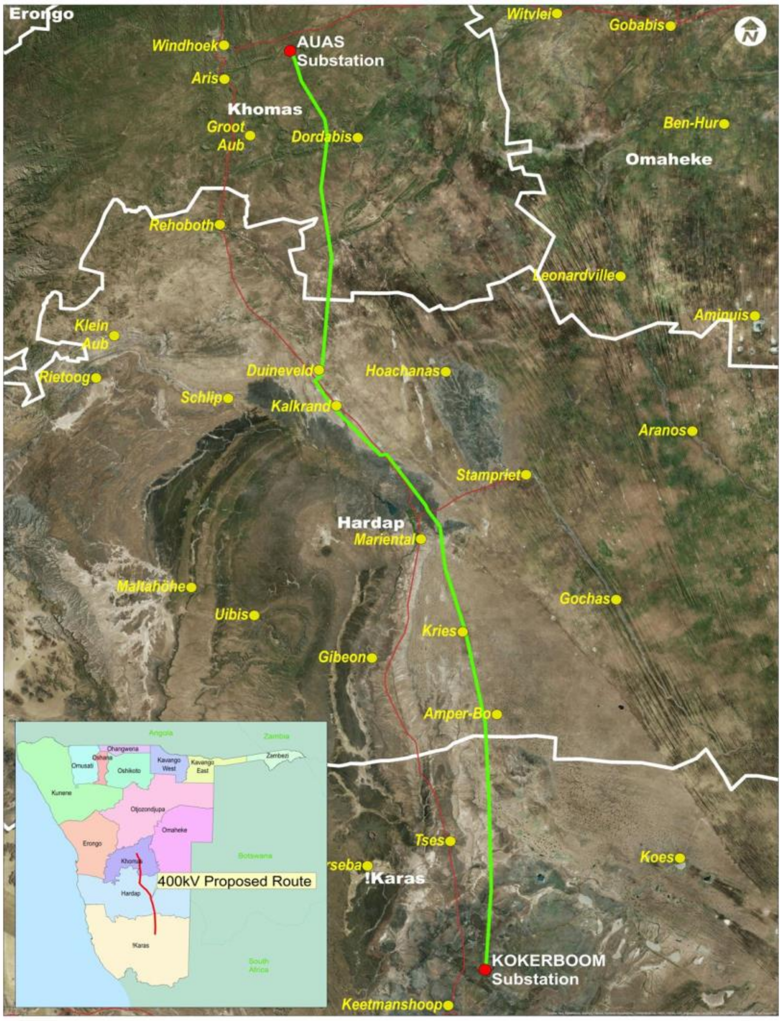

Figure 5 **Locality Plan indicating the proposed alignment of the Kokerboom – Auas Transmission Line Corridor.**

4 ASSESSMENT OF POTENTIAL IMPACTS

Along the route proposed, with the exception of *Acacia erioloba* (camel thorn), relatively low numbers of individuals belonging to species of concern might be damaged or destroyed, mostly during the construction phase of the proposed project, but this is unlikely to compromise their conservation status to any appreciable degree. As indicated in Section 1.5.1 (Methodology), all plant species of conservation concern that might conceivably occur within the proposed servitude (endemic, near-endemic, protected, Red Data species) have been reviewed to assess the possibility of them, or their habitat, being negatively affected to an extent that would compromise their present conservation status to a degree that should cause concern and constitute a fatal flaw or necessitate any mitigation actions.

This is because the project is linear and relatively narrow, greatly limiting the probable extent of impact on any habitat or species.

However, the present route travels over areas in Sections B and C where there are dense stands of *Acacia erioloba*, including many of appreciable size and age. Impacts on this species will have to be strictly constrained.

4.1 Identification of Potential Impacts

The potential impacts of the proposed project on the vegetation of the receiving environment are described in terms of the following criteria:

a) Nature of the impact
b) Extent of the impact
c) Duration of the impact
d) Intensity
e) Reversibility
f) Irreplaceability
g) Consequence
h) Probability of occurrence
i) Significance
j) Degree of confidence in predictions
k) Cumulative impacts.

The table below provides a summary of the criteria and the rating scales used to rate the impacts.

Criteria	Rating Scales	Notes
Nature	**Positive**	This is an evaluation of the type of effect the construction, operation and management of the proposed development would have on the affected environment. Would it be positive, negative or neutral?
	Negative	

Criteria	Rating Scales	Notes
	Neutral	
Extent This refers to the spatial scale at which the impact will occur.	**Low**	Site-specific, affects only the development footprint
	Medium	Local (limited to the site and its immediate surroundings, including the surrounding towns and settlements within a 10 km radius);
	High	Regional (beyond a 10 km radius) to national
Duration	**Low**	Short-term: 0-5 years, typically impacts that are quickly reversible within the construction phase of the project
	Medium	Medium-term, 6-10 years, reversible over time
	High	Long-term, 10-60 years, and continue for the operational life span of the development
Intensity This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered? The specialist studies must attempt to quantify the magnitude of the impacts and outline the rationale used.	**Low**	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected
	Medium	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected
	High	Where natural, cultural or social functions and processes are altered to the extent that the impact will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected.
Degree of Reversibility This considers the ability of the impacted environment to return to its pre-impacted state once the cause of the impact has been removed.	**Low**	Impacted natural, cultural or social functions and processes will return to their pre-impacted state within the short-term.
	Medium	Impacted natural, cultural or social functions and processes will return to their pre-impacted state within the medium to long term.
	High	Impacted natural, cultural or social functions and processes will never return to their pre-impacted state.
Potential for impact on irreplaceable resources This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could possibly be replaced by natural processes (e.g. by natural colonisation from surrounding areas), through artificial means (e.g. by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems substitutes are often possible (e.g. by constructing new social facilities for those that are lost). In contrast, red data species that are restricted to a particular site or habitat of very limited extent are likely irreplaceable..	**Low**	No irreplaceable resources will be impacted.
	Medium	Resources that will be impacted can be replaced, with effort.
	High	There is no potential for replacing a particular vulnerable resource that will be impacted.
Consequence The consequence of the potential impacts is a summation of above criteria, namely the extent, duration, intensity and impact on irreplaceable resources.	**Low**	A combination of any of the following • Intensity, duration, extent and impact on irreplaceable resources are all rated low • Intensity, duration and extent are rated low but impact on irreplaceable resources is rated medium to high • Intensity is low and up to two of the other criteria are rated medium • Intensity is medium and all three other criteria are rated low
	Medium	• Intensity is medium and one other criteria is rated high, with the remainder being rated low • Intensity is low and at least two other criteria are rated medium or higher • Intensity is rated medium and at least two of the other

Criteria	Rating Scales	Notes
		criteria are rated medium or higher • Intensity is high and at least two other criteria are medium or higher • Intensity is rated low, but irreplaceability and duration are rated high
	High	• Intensity and impact on irreplaceable resources are rated high, with any combination of extent and duration • Intensity is rated high, with all of the other criteria being rated medium or higher
Probability The probability of the impact actually occurring, based on professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between probability of the **impact** occurring and probability that the **activity causing a potential impact** will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact. The fact that an activity will occur does not necessarily imply that an impact will occur. For instance, the fact that a road will be built does not necessarily imply that it will impact on a wetland. If the road is properly routed to avoid the wetland, the impact may not occur at all, or the probability of the impact will be low, even though it is certain that the activity will occur.	**Low**	Improbable. It is highly unlikely or less than 50 % likely that an impact will occur.
	Medium	Distinct possibility. It is between 50 and 70 % certain that the impact will occur.
	High	Most likely. It is more than 75 % certain that the impact will occur or it is definite that the impact will occur.
Significance Impact significance is defined to be a combination of the consequence (as described below) and probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact actually occurring. The following analogy provides an illustration of the relationship between consequence and probability. The use of a vehicle may result in an accident (an impact) with multiple fatalities, not only for the driver of the vehicle, but also for passengers and other road users. There are certain mitigation measures (e.g. the use of seatbelts, adhering to speed limits, airbags, anti-lock braking, etc.) that may reduce the consequence or probability or both. The probability of the impact is low enough that millions of vehicle users are prepared to accept the risk of driving a vehicle on a daily basis. Similarly, the consequence of an aircraft crashing is very high, but the risk is low enough that thousands of passengers happily accept this risk to travel by air on a daily basis. In simple terms, if the consequence **and** probability of an impact is high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.	**Low**	• Low consequence and low probability • Low consequence and medium probability • Low consequence and high probability
	Low to medium	• Low consequence and high probability • Medium consequence and low probability
	Medium	• Medium consequence and low probability • Medium consequence and medium probability • Medium consequence and high probability • High consequence and low probability
	Medium to high	• High consequence and medium probability
	High	• High consequence and high probability

Criteria	Rating Scales	Notes
Degree of confidence in predictions Specialists are required to provide an indication of the degree of confidence (low, medium or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. Degree of confidence is not taken into account in the determination of consequence or probability.	**Low** **Medium** **High**	

The impacts will be further evaluated in accordance with the rating tables provided in **Section 4.3**.

4.1.1 Construction Phase

Direct destruction of, or damage to, protected and/or endemic plant species, *Acacia erioloba* in particular. Illegal collection of plant material such as wood or pods.

4.1.2 Operational Phase

Direct destruction of, or damage to, protected and/or endemic plant species, *Acacia erioloba* in particular. Illegal collection of plant material such as wood or pods.

4.1.3 Decommissioning Phase

Direct destruction of, or damage to, protected and/or endemic plant species, *Acacia erioloba* in particular. Illegal collection of plant material such as wood or pods.

4.1.4 Cumulative impacts

Acacia erioloba is being over-harvested for wood and for pods at present. Cumulative impacts are likely to be of concern in future.

4.2 Mitigation of Impacts

The basic principle of mitigation is to guide development to either avoid potential negative impacts or achieve the least possible negative impact on resources. Mitigation measures are designed to reduce the consequence or probability of an impact, or to reduce both consequence and probability.

4.2.1 Minimising damage to protected trees

Whenever possible trees, in particular camel thorn trees (*Acacia erioloba*), should be trimmed rather than destroyed. This applies particularly to the construction and operational phases.

Wherever possible pylon sites should be carefully selected and placed so as to avoid pan edges, banks of rivers and other drainage lines, and large camel thorn trees.

Creation of additional tracks, including those made by bulldozers and other large construction vehicles, outside of the service track should be not be permitted unless absolutely necessary.

Staff camps should be pre-determined and marked.

Penalties should be in place for all contractors and sub-contractors that cause unnecessary collateral damage.

4.2.2 Wood and plant collection

Random collection of wood for fuel and/or heating should be forbidden. No harvesting of wood by operational/maintenance staff should be permitted. Any wood used by staff for any purpose whatsoever must be permitted wood supplied by the farmers along the route themselves, or be invader species wood sourced from elsewhere.

Plant collection of any plants or parts thereof, including seeds and pods, should be forbidden.

Penalties, including dismissal for repeat offenders, should be in place for all transgressors.

4.3 Impact Rating Tables

A rating table has been completed for each identified impact in each phase of the proposed project lifetime, without and with effective mitigation measures in place.

The table below outlines predicted environmental impacts on the vegetation during the construction phase.

Table 4.1: Construction Phase Impacts Without and With Mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 1: Direct destruction to species of conservation concern, in particular protected tree species.										
Impact Description: Bulldozing and clearing of vegetation, vehicle damage.										
Without Mitigation	-	Medium	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Strict control of tracks and vehicle turning points. Fixed point photography prior to work starting to provide a baseline comparison. Raking of all but one service track that will be needed in future.										
With Mitigation	-	Low	High	Low	Low	Low	Low	Medium	Low	High
Cumulative Impact: If impacts on *Acacia erioloba* and unnecessary track proliferation are not controlled the cumulative damage will be greatly increased.										

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 2: Illegal wood or pod harvesting or removal of other plant species for fuel or other purposes (e.g. selling)										
Impact Description: Harvesting of wood/pods/plants/seeds for fuel, heating or selling.										
Without Mitigation	-	Medium	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Indicate if mitigation is possible. If yes, describe.										
With Mitigation	-	Low	Low	Low	Low	Low	Low	Medium	Low	Medium
Cumulative Impact: Woody vegetation in the area can very easily be heavily impacted if wood/pod removal is not controlled. Because species like *Acacia erioloba* are so slow-growing, and often experience sporadic recruitment, impacts can be long-term. The pressures on these resources are increasing country-wide, exacerbated by charcoal harvesting, and cumulative impacts are likely to be considerable.										

Table 4.2: Operational Phase Impacts Without and With Mitigation

The table below outlines predicted environmental impacts on the vegetation during the operational phase.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 1: Direct destruction to species of conservation concern, in particular protected tree species.										
Impact Description: Bulldozing and clearing of vegetation, vehicle damage.										
Without Mitigation	-	Low	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Strict control of tracks and vehicle turning points. Fixed point photography prior to work starting to provide a baseline comparison. Raking of all but one service track that will be needed in future.										
With Mitigation	-	Low	High	Low	Low	Low	Low	Medium	Low	High
Cumulative Impact: If impacts on *Acacia erioloba* and unnecessary track proliferation are not controlled the cumulative damage will be greatly increased.										

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact 2: Illegal wood or pod harvesting or removal of other plant species for fuel or other purposes (e.g. selling)										
Impact Description: Harvesting of wood/pods/plants/seeds for fuel, heating or selling.										
Without Mitigation	-	Low	High	Medium	Medium	Medium	Medium	High	Medium	High
Mitigation Description: Indicate if mitigation is possible. If yes, describe.										
With Mitigation	-	Low	Low	Low	Low	Low	Low	Medium	Low	Medium
Cumulative Impact: Woody vegetation in the area can very easily be heavily impacted if wood/pod removal is not controlled. Because species like *Acacia erioloba* are so slow-growing, and often experience sporadic recruitment, impacts can be long-term. The pressures on these resources are increasing country-wide, exacerbated by charcoal harvesting, and cumulative impacts are likely to be considerable.										

5 CONCLUSIONS AND RECOMMENDATIONS

The proposed Kokerboom to Auas transmission line corridor traverses three distinct vegetation zones, of which the Highland Savanna is the most sensitive, supporting numerous endemic and/or protected species. However, in that zone most of the species of high concern occur on the slopes of koppies and mountains, which are largely avoided at present.

Impact throughout the route will be highest on protected trees, which must be conserved as far as possible. Given careful placement of pylon sites and strict control of tree removal and unnecessary collateral damage, as well as uncontrolled wood/pod harvesting, the impact on plants could be relatively low. The species of highest concern is camel thorn (*Acacia erioloba*).

It is my opinion as an independent, experienced vegetation specialist that a field study for vegetation is unnecessary for this proposed project, unless the transmission line corridor route reviewed here is altered such that it impinges to an appreciably greater extent on the higher slopes and koppies of the Highland Savanna, in which case a field study should be undertaken.

6 VEGETATION MANAGEMENT PLAN

Over much of the proposed transmission line corridor route vegetation management is likely to be minimal, and inspection of existing servitudes indicated that the methods presently used by Nampower are suitable.

Thus please note that the recommendations below apply only to areas where manual methods as ordinarily applied by Nampower (Nampower General Environmental Management Plan for the Construction of Powerlines) have proven inadequate, such as severely bush-encroached areas where chemical control is unavoidable.

6.1 Appropriate methods of vegetation clearing

Where vegetation is very dense and woody, with a number of indigenous but invasive and persistent species obviously a problem, it may be necessary to use arboricides. Many of the problem species are resprouters that rebound from previous mechanical clearing, usually with a large root biomass and the roots very well anchored. This makes the application of an arboricide more appropriate in the long run.

Although arboricides do have potential side effects, certain types are perfectly acceptable, if used carefully.

In the case of the following woody species:

Acacia mellifera subsp. *detinens*
Acacia reficiens
Acacia hebeclada subsp. *hebeclada*
Catophractes alexandri
Lycium bosciifolium
Rhigozum trichotomum
Tarchonanthus camphoratus

a foliar based arboricide, such as Access™ , applied to coppice growth from previously chopped or graded stumps is appropriate.

Once the arboricide is applied there should be little regrowth. However, it is not 100 % effective and a follow up in the following season will be necessary. Smaller, younger plants with root diameters of less than 40 mm or so can be levered out with a TreePopper. This should be done in the rainy season since it is easier to lever the roots out when the soil is moist. It is important to distinguish between saplings and resprouting individuals with larger root systems. The Tree Popper will not be effective in pulling out resprouts with larger root systems.

6.2 Recommendations:

In summary, the use of AccessTM is recommended for the clearing of most problematic woody shrubs *that persist after manual clearing*.

Recommended dosages and application methods given in the manual should be strictly adhered to.

The effectiveness of the foliar application is best at least 4 hours before it starts to rain (Honsbein, 2012).

Because of the hairiness of the leaves of *Catophractes alexandri* it is recommended that initial chopping or even cutting with a chain saw is followed up with the application of AccessTM to the cut stump. This is labour intensive but will increase the effectiveness greatly. If this does not work, a *limited* application of one of the tebuthiuron based soil applied arboricides in restricted areas *away from drainage lines* would be acceptable.

If AccessTM is applied to a cut stump it should be done very soon after cutting to ensure that the active ingredient, picloram, is able to enter the wound.

Annual monitoring should be done to determine the success rate, regrowth and sapling growth.

After one follow up, a year later, there should be no need to apply arboricides, and a Tree Popper could be used to deal with recruiting saplings. Levering out with the Tree Popper should take place in the wet season, to ensure maximum success.

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APPENDIX 1: LIST OF PLANT SPECIES ASSESSED FOR FURTHER ACTION

Species	Conservation status	Range in Namibia	Habitat if restricted	Occurrence in vicinity of proposed route if of possible concern	Notes
Acacia erioloba	Protected	Widespread			Can be mitigated
Acrotome fleckii	Endemic	Widespread			
Aizoon giessii	Endemic	Reasonably widespread			
Albizia anthelmintica	Protected	Widespread			Can be mitigated
Aloe dichotoma	Protected	Widespread, sometimes in dense stands			Can be mitigated
Aloe littoralis	Protected	Widespread, sometimes in dense stands			Can be mitigated
Aloe viridiflora	Endemic, Protected	Restricted, disjunct	Mountain slopes	Farm Rietfontein, Hohensh(t?)ein mountain	Unlikely to be affected, known locality far from route and terrain unsuitable
Anacampseros filamentosa subsp. *tomentosa*	Endemic, Protected	Reasonably widespread			
Antiphiona pinnatisecta	Endemic	Widespread			
Aptosimum arenarium	Endemic	Widespread			
Barleria dinteri	Endemic	Somewhat restricted but common where it occurs			
Boscia albitrunca	Protected	Widespread			Can be mitigated
Cleome suffruticosa	Endemic	Widespread			
Convolvulus argillicola	Endemic	Reasonably widespread			

Crotalaria kurtii	Endemic	Reasonably widespread			
Cyperus rehmii	Endemic	Known distribution highly restricted but almost certainly undercollected	Pans, seasonally wet areas	Farm Binsenheim/ Rietfontein	Unlikely to be affected, but can mitigate
Dicoma dinteri	Endemic	Very restricted, only known from two quarter degree squares	Rocky soil in vicinity of Windhoek on slopes, koppies and mountains in scattered localities	Farm Finkenstein., Farm Binsenheim/ Rietfontein	Unlikely to be of concern, records from relatively far away from route, on slopes.
Eragrostis omahekensis	Endemic	Widespread			
Eragrostis scopelophila	Endemic	Widespread			
Erythrina decora	Endemic, Protected	Widespread but uncommon	Mountains, in scattered localities, often on steep gorge slopes		Unlikely to be affected, usually on steep,high slopes
Euclea pseudebenus	Protected	Widespread			Can be mitigated
Felicia smaragdina	Endemic	Widespread			
Ficus cordata	Protected	Widespread			Can be mitigated
Geigeria plumosa	Endemic	Widespread			
Hibiscus dinteri	Endemic	Widespread			
Hibiscus discophorus	Endemic	Restricted range but common when it occurs. Undercollected due to being inconspicuous.	Rocky-sandy slopes.		
Hibiscus fleckii	Endemic	Widespread			
Indigofera hochstetteri subsp.	Endemic	Widespread			

Streyana					
Indigofera pechuelii	Endemic	Widespread			
Jamesbrittenia barbata	Endemic	Widespread			
Jamesbrittenia lyperioides	Endemic	Reasonably widespread			
Jamesbrittenia primuliflora	Endemic	Reasonably widespread			
Justicia guerkeana	Endemic	Widespread			
Lapeirousia gracilis	Endemic	Widespread			
Lebeckia obovata	Endemic	Reasonably widespread			
Maerua schinzii	Protected	Widespread			Can be mitigated
Manulea dubia	Endemic	Widespread			
Manuleopsis dinteri	Endemic	Widespread			
Merremia bipinnatipartita	Endemic	Widespread			
Monechma grandiflorum	Endemic	Restricted, disjunct	Rocky ridges	Below dam wall, Hardap Dam	Unlikely to be affected
Nicolasia heterophylla subsp. affinis	Endemic	Somewhat restricted, probably undercollected	Vleys/ pans	Farm Gravenstein REH 65	Unlikely to be affected
Nicolasia heterophylla subsp. heterophylla	Endemic	Somewhat restricted, probably undercollected	Vleys/ pans	Farm Gravenstein REH 65: Vley at Ramposten	Unlikely to be affected
Ondetia linearis	Endemic	Widespread			
Ornithogalum candidum	Endemic	Reasonably widespread			
Ornithogalum stapfii	Endemic	Widespread			
Ornithogalum tubiforme	Endemic	Reasonably widespread, ephemeral so almost certainly undercollected			
Osteospermum montanum	Endemic	Reasonably widespread			
Pegolettia pinnatilobata	Endemic	Reasonably widespread			
Pennisetum foermeranum	Endemic	Reasonably widespread			
Peristophe	Endemic	Widespread			

hereroensis					
Petalidium linifolium	Endemic	Reasonably widespread			
Rogeria bigibbosa	Endemic	Reasonably widespread			
Searsia lancea	Protected	Widespread			
Selago amboensis	Endemic	Reasonably widespread			
Selago lepida	Endemic	Reasonably widespread			
Solanum dinteri	Endemic	Widespread			
Stapelia flavopurpurea	Protected	Widespread			
Thesium xerophyticum	Endemic	Disjunct, somewhat restricted, scattered but common where it occurs, undercollected - probably due to being very nondescript	Rocky mountain and koppie slopes	Mountains and koppies on Farm Voigtland	Unlikely to be affected
Ziziphus mucronata	Protected	Widespread			Can be mitigated

PROPOSED KOKERBOOM - AUAS 400 KV TRANSMISSION LINE

ENVIRONMENTAL IMPACT ASSESSMENT

FLOODLINE ASSESSMENT REPORT
FOR INPUT INTO THE IMPACT ASSESSMENT REPORT

A C Muir
Lithon Project Consultants (Pty) Ltd
P O Box 40902
Windhoek

September 2016

LITHON PROJECT CONSULTANTS (PTY) LTD

18 September 2016

DECLARATION OF INDEPENDENCE

I, Adrian Christian Muir, as duly authorised representative of Lithon Project Consultants (Pty) Ltd confirm my independence (as well as that of Lithon Project Consultants) as a specialist and declare that neither myself nor Lithon Project Consultants have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Lithon Project Consultants (Pty) Ltd was appointed to manage the Environmental Impact Assessment (EIA) process or Ms. Jaana-Maria Ball who was appointed as Environmental Assessment Practitioner in terms of the Environmental Management Act, 2007 (Act No. 7 of 2007) and the EIA Regulations, 2012, other than fair remuneration for work performed, specifically in connection with the EIA process for the proposed Kokerboom to Auas 400 kV transmission line. I further declare that I am confident in the results of the studies undertaken and conclusions drawn as a result of it – within the limitations as are described in my attached report.

My expertise and experience is as follows:

1. Floodline study of the Oanob River downstream of the Oanob Dam. Flood levels were required for the proposed development of erven in Rehoboth situated on the banks of the river.
2. Floodline study for the three major rivers that run through Windhoek, being the Klein Windhoek River, Gammams River and Arebbusch River
3. Evaluation of the flood that caused major damage to Mariental and the Hardap irrigation scheme in 2006.
4. Floodline evaluation for the Sungate development at the Hosea Kutako International Airport.
5. Numerous floodline studies throughout Namibia, including the Fish River at Mariental and the major rivers that pass through Windhoek.

Adrian Christian Muir

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EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

FLOODLINE ASSESSMENT REPORT FOR INPUT INTO IMPACT ASSESSMENT REPORT

EXECUTIVE SUMMARY

This Floodline Assessment Report has evaluated the flood potential generated by the rivers and streams that are found within the transmission line corridor of the proposed Kokerboom to Auas 400 kV power line. This evaluation was used to identify possible impacts, both of the proposed project on the environment and impacts of the environment on the project.

The evaluation included:

- Identifying all rivers and streams that cross the powerline route
- Determining the catchments of all streams that may have an impact on the proposed project
- Collection of available rainfall and run-off data
- Evaluation of the catchment characteristics
- Carrying out the hydrological analysis and estimate the 1 in 50 and 1 in 100 year flows for the significant catchments
- Carrying out a floodline analysis for the significant catchments
- Generation of the 1 in 50 and 1 in 100 year flood levels and floodlines for the significant catchments
- Assessment of the impact of the run-off flows on the proposed project
- Assessment of the cumulative impacts of the proposed project and
- Description of the mitigation measures and management actions to eliminate or reduce potential negative impacts and enhance potential positive impacts.

It was concluded that:

- There are no major drainage catchments in the project area that will significantly affect the construction of the proposed transmission power line.
- The potential impact of floods on the proposed infrastructure is negligible if the proposed mitigation and management actions are implemented. Without mitigation the impact on the cost of repairs to pylons can be significant. Resulting power outages can have major downstream impacts on the Namibian economy.
- No negative impacts are foreseen during the construction and operational phases that cannot be mitigated to an acceptable level of significance.
- Recommended mitigation measures during the construction phase include:
    - Stopping construction activities in the rivers when there is flow
    - Not storing equipment or materials in the 1 in 100 year flood zone of the river
- Recommended mitigation measures during the operational phase include:
    - Proper design and construction of the access track to ensure that it does not create an obstacle to the flow of water
    - Not constructing pylons in the flood zone of the rivers, alternatively
    - Provision of proper erosion protection to pylon bases.

EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

FLOODLINE ASSESSMENT REPORT FOR INPUT INTO THE IMPACT ASSESSMENT REPORT

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TABLES

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GLOSSARY OF TERMS, DEFINITIONS AND ABBREVIATIONS

Affected Environment	Those parts of the socio-economic and biophysical environment impacted on by development
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternatives sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called “no action” alternative may also require investigation in certain circumstances.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that are relevant to the decision.
Catchment area	An area of land where surface water from rain, converges to a single point at a lower elevation, usually the exit of the basin.
DEA	Directorate of Environmental Affairs
Developer (or Project Proponent)	NamPower
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
Environment	Means the surroundings within which humans exist and that are made up of: The land, water and atmosphere of the earth. Micro-organisms, plant and animal life. Any part or combination of a) and b) and the interrelationships among and between them. The physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.
EMP	Environmental Management Plan: The EMPs for the project sets out general instructions that will be included in a contract document for the construction and operational phases of the project. The EMPs will ensure the construction and operational activities are undertaken and managed in an environmentally sound and responsible manner.
Flood return period	A 1 in 50 year flood has a return period of 50 years. Also referred to as a flood that has an annual probability of exceedance of 2%, which is statistically more correct.
Floodline	A line on a topographic map which defines the level to which flood waters will rise for a specified return period.
Hydrology	The science of collecting and analysing data needed to predict runoff from a catchment and using the data to determine flows (normally in m^3/s) at a defined point in a stream for different return periods
kV	kilo volts

m^3/s	cubic metres per second
MET	Ministry of Environment and Tourism
Project	This refers to all construction activities associated with the proposed activities.

1 INTRODUCTION

1.1 Background

The route of the proposed Kokerboom to Auas transmission line traverses the central area of Namibia from south to north over a distance of approximately 500 km. The line commences at the Kokerboom sub-station which lies 23 km north east of Keetmanshoop and extends to the Auas sub-station, 30 km east of Windhoek. There are two existing transmission lines connecting the two substations, one of 220 kV and the second of 400 kV. The Project Area is shown in **Figure 1.1.**

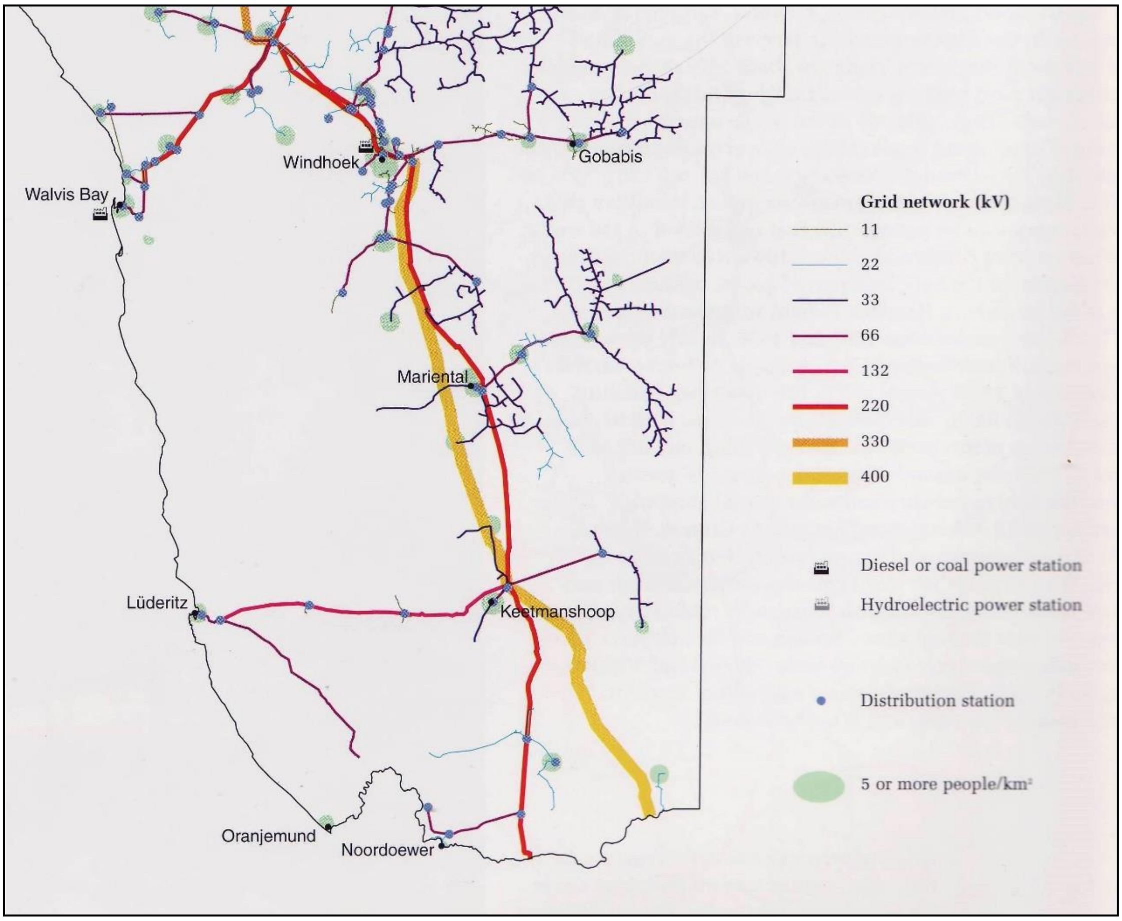

Figure 1.1: Project Area showing existing Powerlines

Rainfall and run-off provide the essential data required for this Specialist Study. Keetmanshoop, with a mean annual rainfall of 150 mm is considerably drier than Windhoek which has a mean annual rainfall of 360 mm. The average maximum temperature at Keetmanshoop during the hottest month is 34 - 36°C while in Windhoek it is 32 - 34°C.

A map of the mean annual rainfall of Namibia is shown in **Figure 1.2**.

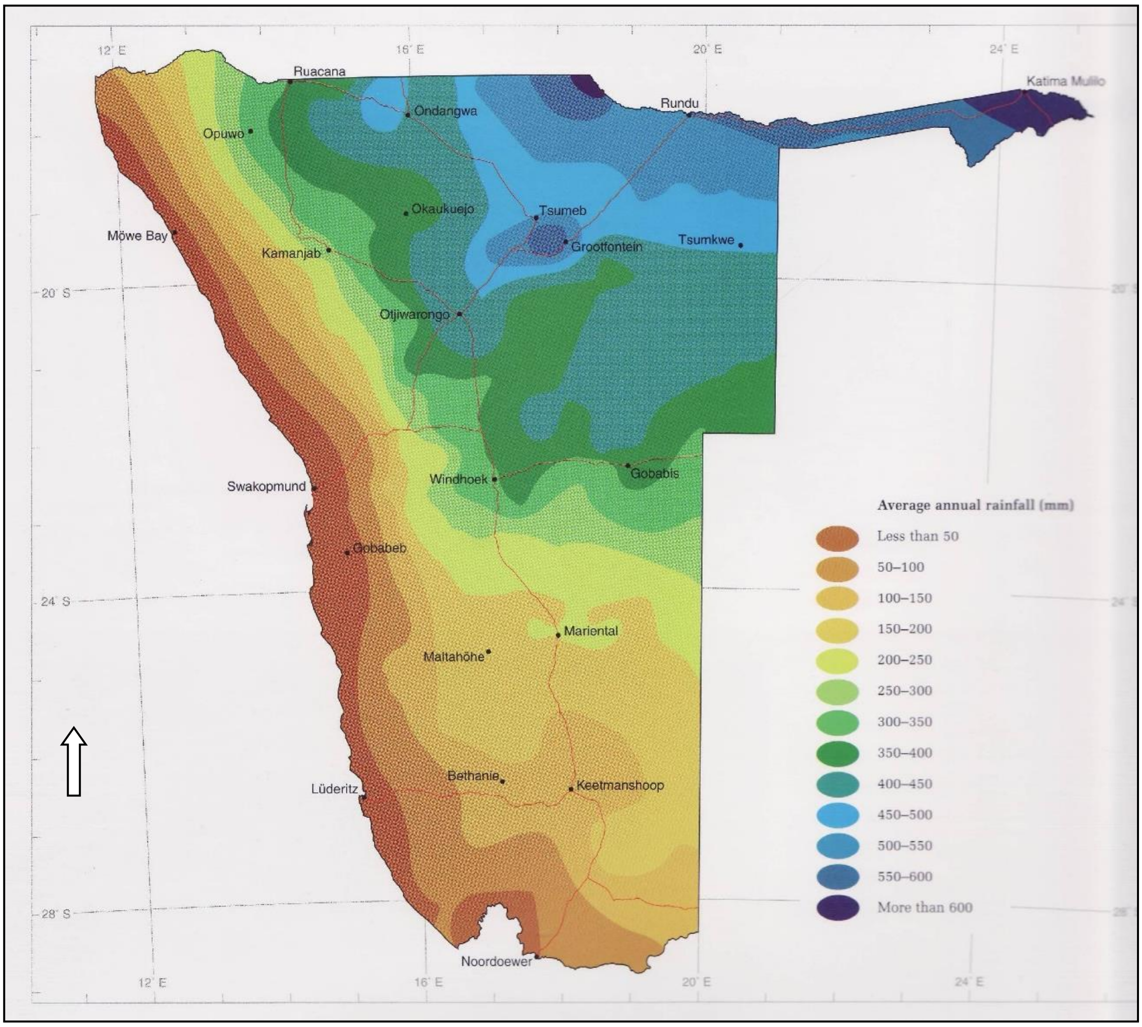

Figure 1.2: Mean Annual Rainfall

The purpose of this Specialist Report is to evaluate the route with respect to the risk of possible flooding. Where required the floodline for larger catchments will be determined. Powerlines in the project area are shown in **Figure 1.1**. These existing lines will provide historical data on the risk faced by powerlines in the project area from flooding.

This assessment and Report do not consider alternative routes in detail since the alternative routes (including the 'no-go' alternative) were scoped out for various environmental factors (biophysical and socio-economic) (refer to **Section** Error! Reference source not found.). The favoured alternative i.e. proposed new route will run parallel to the existing 400 kV power line servitude for the majority of its length. The potential impacts of possible floods and proposed mitigation measures will be assessed.

This independent Floodline Assessment Study forms part of the full Environmental Impact Assessment (EIA) process (i.e. Screening, Scoping and Impact Assessment phases) undertaken and which the documentation emanating therefrom will be submitted to the competent authority, The Directorate of Environmental Affairs: Ministry of Environment and Tourism (MET-DEA), for decision-making. The EIA is being undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966) and the EIA Regulations, 2012.

The EIA will assess the environmental acceptability of constructing, operating and maintaining a power line in the area with a length of approximately 500 km and a transmission line corridor width of 500 m (250 m from the centre line). The final servitude width will be 80 m, with 12 m of that being cleared for an access track. The access track will be used to bring in construction materials, as well as being used to access the power line and its associated pylons for maintenance purposes. Emphasis was placed on the optimisation of the route as well as the cumulative impacts of three major power lines, generally running parallel to one another, within the study area.

This Floodline Assessment considers the impacts of constructing and operating (including maintaining) the proposed transmission line and its associated infrastructure, such as the access track, within the 500 km long and 500 m wide transmission line corridor.

The main objective of the Impact Assessment phase of the EIA is to identify all the potential significant impacts and recommend mitigating measures to eliminate or reduce the effect of the negative impacts, and enhance the effect of the positive impacts.

1.2 Study Objectives

This assessment's objectives are to assess the potential impacts of the surface run-off on the proposed project infrastructure, as well as the potential impacts of the proposed project on the streams and floodlines of the study area. A further objective is to suggest mitigation measures and management actions to either avoid or reduce the potential negative impacts to an acceptable level or enhance any potential positive impacts.

1.3 Report Content

The content of the Floodline Assessment Report is consistent with the requirements for specialist studies as set out in the Environmental Management Act, 2007 (Act No. 7 of 2007) and the EIA Regulations, 2012.
The content of the Report includes the following:

- Contact details of the author, Mr C. Muir, which are presented on Pages 1 and 2 of this Report, and his Declaration of Independence
- Description of the receiving environment
- Methodology for the floodline assessment
- Prediction of the anticipated environmental impacts
- Prediction of the impacts of the hydrology on the proposed project infrastructure, and
- Proposed mitigation measures.

1.4 Details of the Principal Parties

The Project Proponent/ Applicant is NamPower a state utility whose mandate is to generate, transmit and distribute bulk power in Namibia.

The EIA process is being managed by Lithon Project Consultants (Pty) Ltd and the appointed EAP is Ms. Jaana-Maria Ball who is a registered Reviewer and Senior Practitioner with the Environmental Assessment Practitioners Association of Namibia (EAPAN). She prepared all the documentation emanating from this process.

This independent Flood Assessment study was undertaken by Mr. C. Muir of Lithon Project Consultants (Pty) Ltd to inform the assessment of the potential impacts arising from this proposed development.

The contact details, expertise and experience as well as a Declaration of Independence by Mr. Muir are found on Page 1 of this Report.

1.4.1 Scope of Work

The scope of work for the Flood Assessment is:

- Assess the environmental acceptability of constructing, operating and maintaining a power line within the study area

- Optimise the power line route taking environmental, social and technical constraints into consideration
- Define the floodlines for the larger rivers and catchments
- Assess potential impacts of the proposed power line on the hydrology, as well as assess the potential impacts of the proposed project infrastructure on the environment, and
- Indicate all possible mitigation measures to be considered in order to ensure that the proposed powerline is constructed and operated in the most sustainable manner, and to maximise environmental benefits.

1.5 Study Approach

The study approach entails the following steps:

- Define all streams that cross the proposed power line route
- Determine the catchments of all streams that may have an impact on the proposed project
- Collect available rainfall and run-off data
- Carry out the hydrological analysis and estimate the 1 in 50 and 1 in 100 year flows. This will be done in accordance with the Namibian Drainage Manual (Roads Authority Manual, 2012)
- Carry out a floodline analysis for the significant catchments
- Generate floodlines for the significant catchments
- Assess the impact of the run-off flows on the project
- Assess cumulative impacts of the proposed project and existing and planned facilities within the study area and
- Describe mitigation measures and management actions to eliminate or reduce potential negative impacts and enhance potential positive impacts.

The information sources for the study are the:

- Namibia Meteorological Services
- Ministry of Agriculture, Water and Forestry
- Namibia Water Corporation (Pty) Ltd and
- NamPower

1.5.1 Assumptions and Limitations

The assumptions for the Floodline Assessment are:

- Sufficient rainfall data with the required accuracy is available for the study area and that the
- Available digital elevation model is sufficiently accurate for this assessment.

The limitations of the study will be the lack of run-off data for the study area with which to calibrate the hydrological analysis.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

Apart from the five border rivers, namely the Kunene, Okavango, Linyanti and Zambezi Rivers in the north and Orange River in the south, there is no river in Namibia that conveys water throughout the year. The largest river in the interior is the Fish River, which is impounded by the Hardap Dam near Mariental. Even this river flows only a few weeks to some months in the year. Nevertheless, considerations related to floods are decisive in estimating extreme flows in the ephemeral rivers which prevail in the study area.

The Study Area is shown in **Figure 2.1**.

A drainage Map of the Study Area is shown in **Figure 2.2**.

The study area is characterised by extreme droughts and years of high rainfall. The average annual rainfall in the Fish River catchment, which is typical of the southern and central areas of the project area, is between 150 and 250 mm. The variations from these values can be considerable. As an illustration the area experienced rainfall of 675 mm for the big rain year of 1933/34 and only 45 mm for the drought year 1944.

Runoff values show an even stronger variation than the rainfall values. Variations in the annual water flows measured in the Fish River vary between 1 x 10^6 and 1 000 x 10^6.

Namibia may be a very dry country, but it is in general not a country with low flood runoff. High intensity rainfall often falls in a very short time and catchments also run off in a short time. This results in steep flood waves with high peak values. A reasonably reliable estimate of floods requires the availability of rainfall and runoff values. While there is a reasonable record of rainfall measurements, runoff measurements are more scarce.

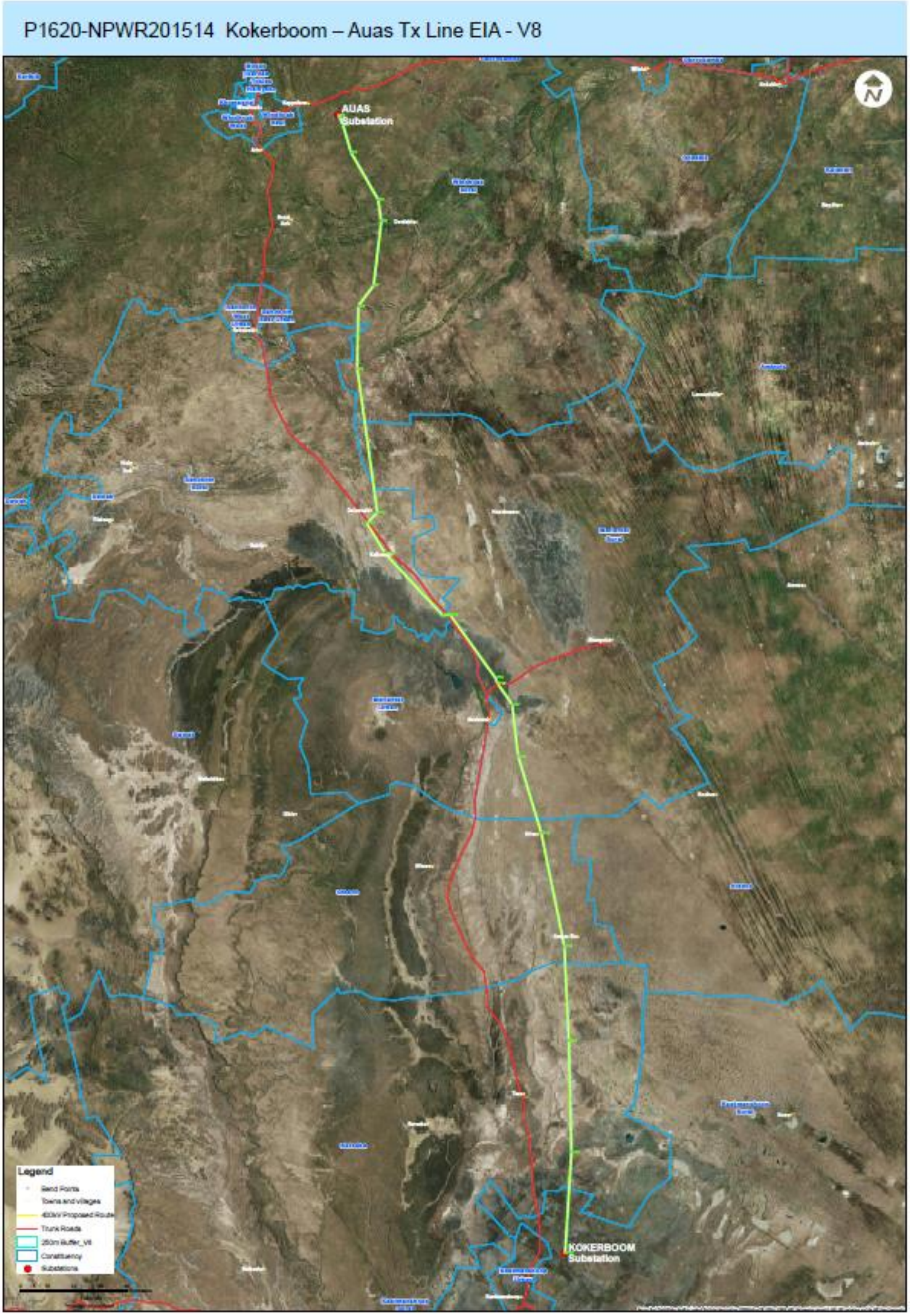

Figure 2.1: Study Area showing the proposed centre lines of the proposed 400 kV Transmission Line

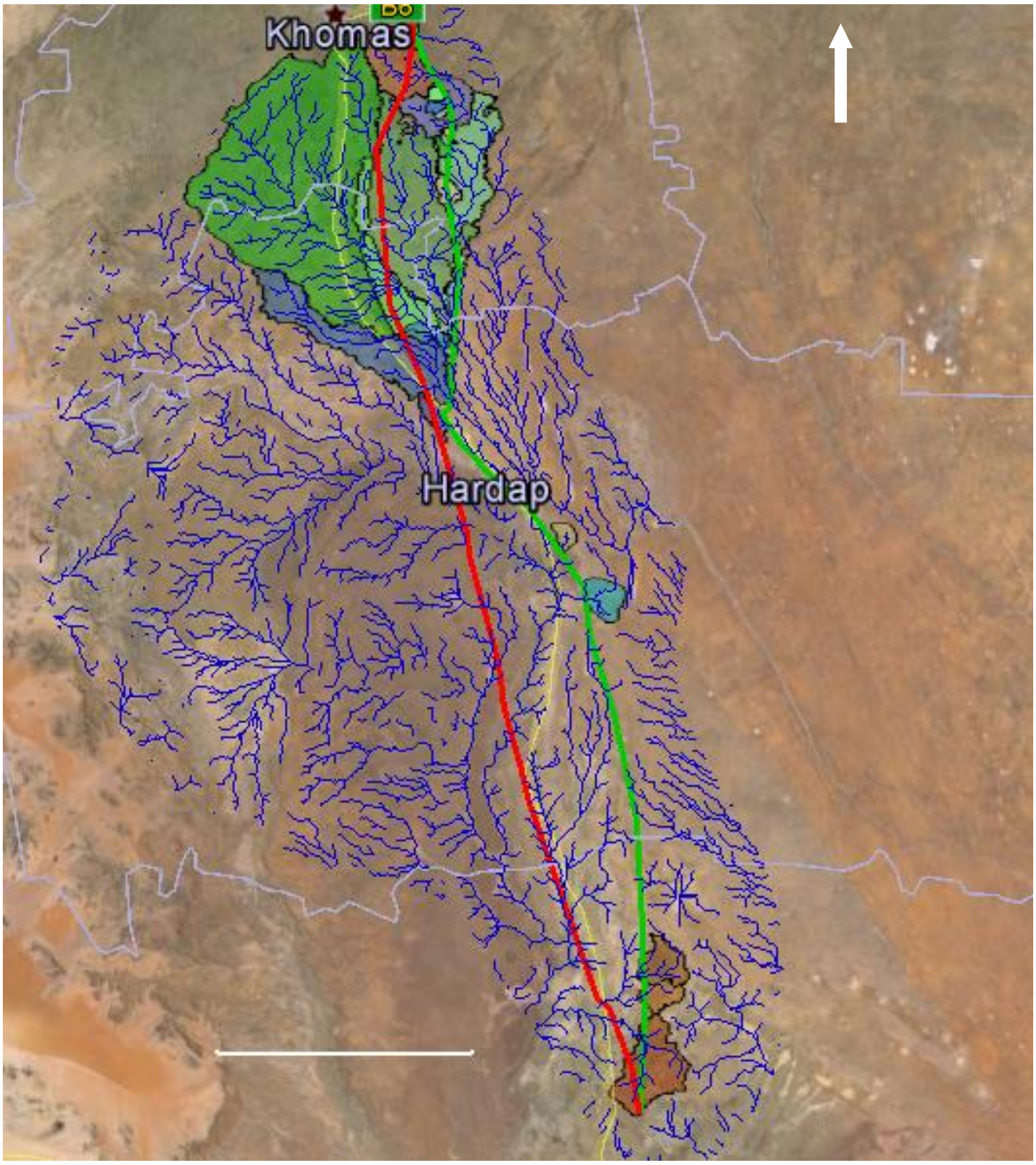

Figure 2.2: Drainage Map of the Study Area

It should be noted that the route of the proposed 400 kV line does not traverse the Fish River catchment. However, the existing 400 kV line does.

For purposes of describing the affected environment, the route will be sub-divided into three sections as the drainage characteristics of these sections differ.

2.1 Transmission Line Route – Section 1

Section 1 commences at the Kokerboom sub-station and extends north for approximately 75 km. This section of the powerline traverses the eastern edge of the Fish River catchment.

Five catchments of interest drain towards, and cross the power line route. They are shown in **Figure 2.3**.

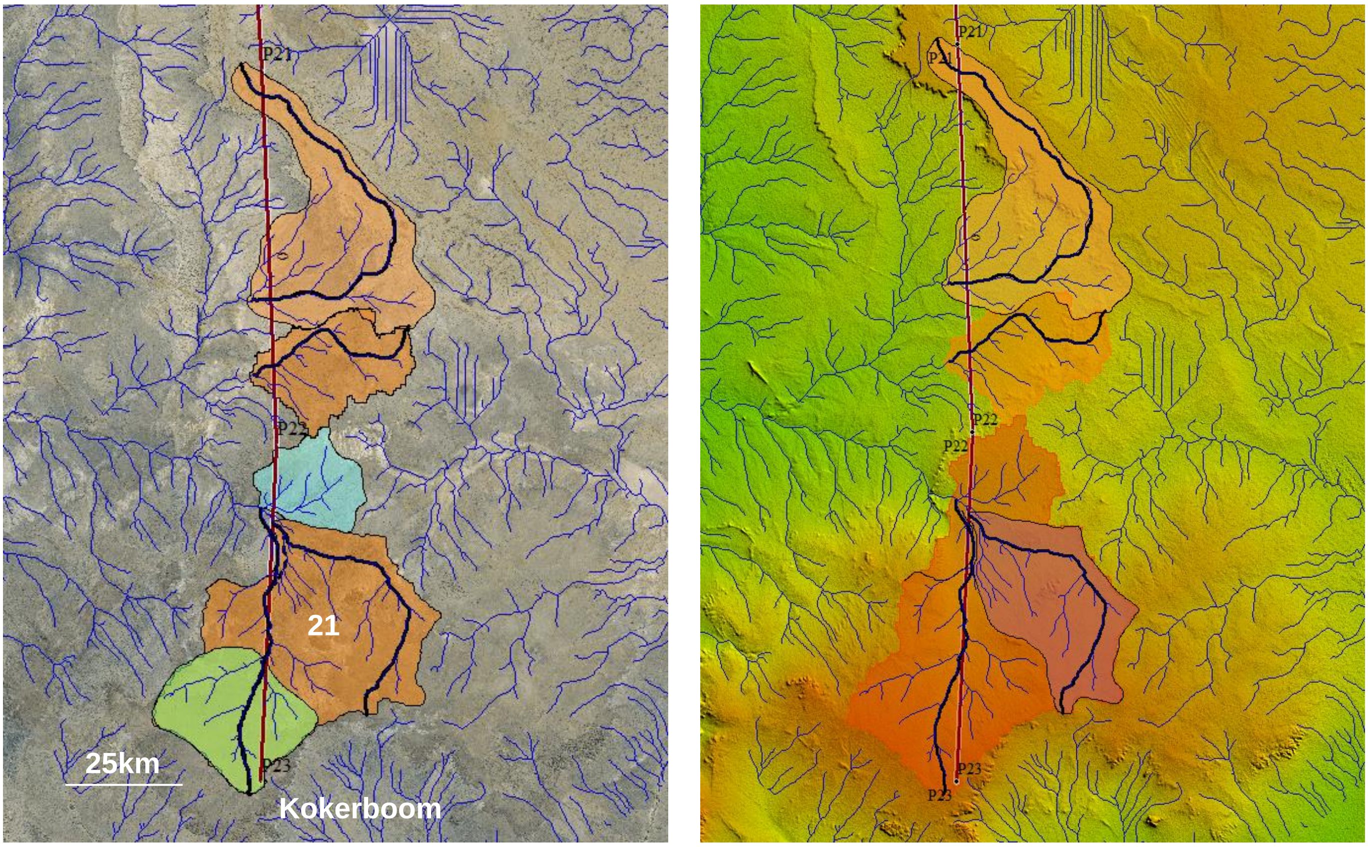

Figure 2.3: Drainage – Section 1

2.2 Transmission Line Route – Section 2

Section 2 extends north for a further 210 km up to the town of Kalkrand. This section of the line runs mainly along the top of the plateau which forms the eastern border of the Fish River catchment. For most of its length the power line runs along the watershed that forms the catchment boundary between the Fish River to the west and the Aub River to the east. Except for two relatively small catchments there are no drainage areas of interest.

The two catchments are the Dabib and Auob Rivers that flow into the Fish River north of Mariental.

The Section 2 route and drainage are shown in **Figure 2.4**.

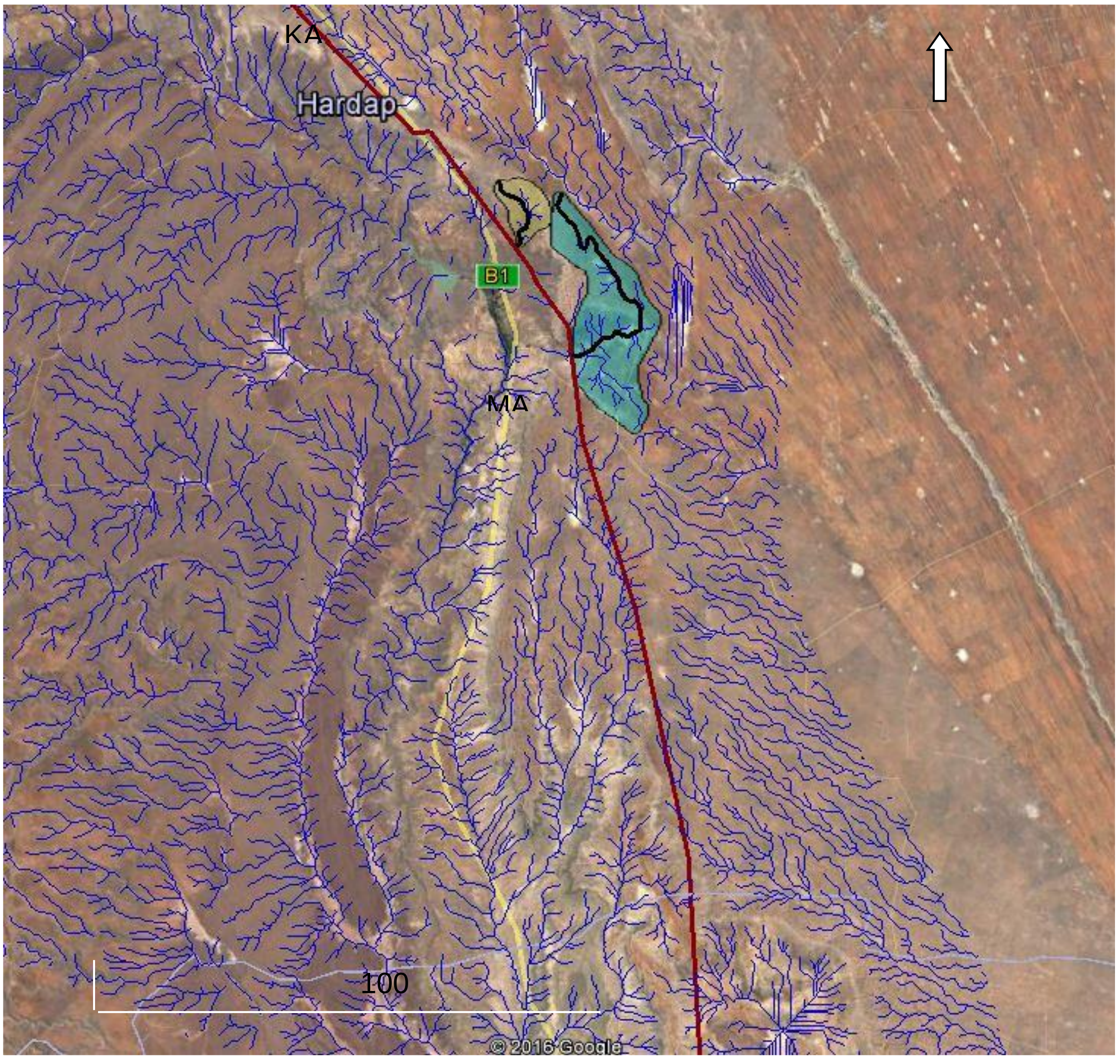

Figure 2.4: Drainage – Section 2

2.3 Transmission Line Route – Section 3

Section 3 extends from Kalkrand northwards to the Auas sub-station over a distance of approximately 170 km. This section traverses the area with the biggest challenge related to drainage. The area principally drains from the Auas Mountains just south of Windhoek. This is also the area with the highest rainfall within the proposed corridor alignment.

The largest catchment is the one that drains the Oanob River. This is a large catchment with a significant 1 in 100 year flow magnitude which will be discussed in **Section 5** of the report.

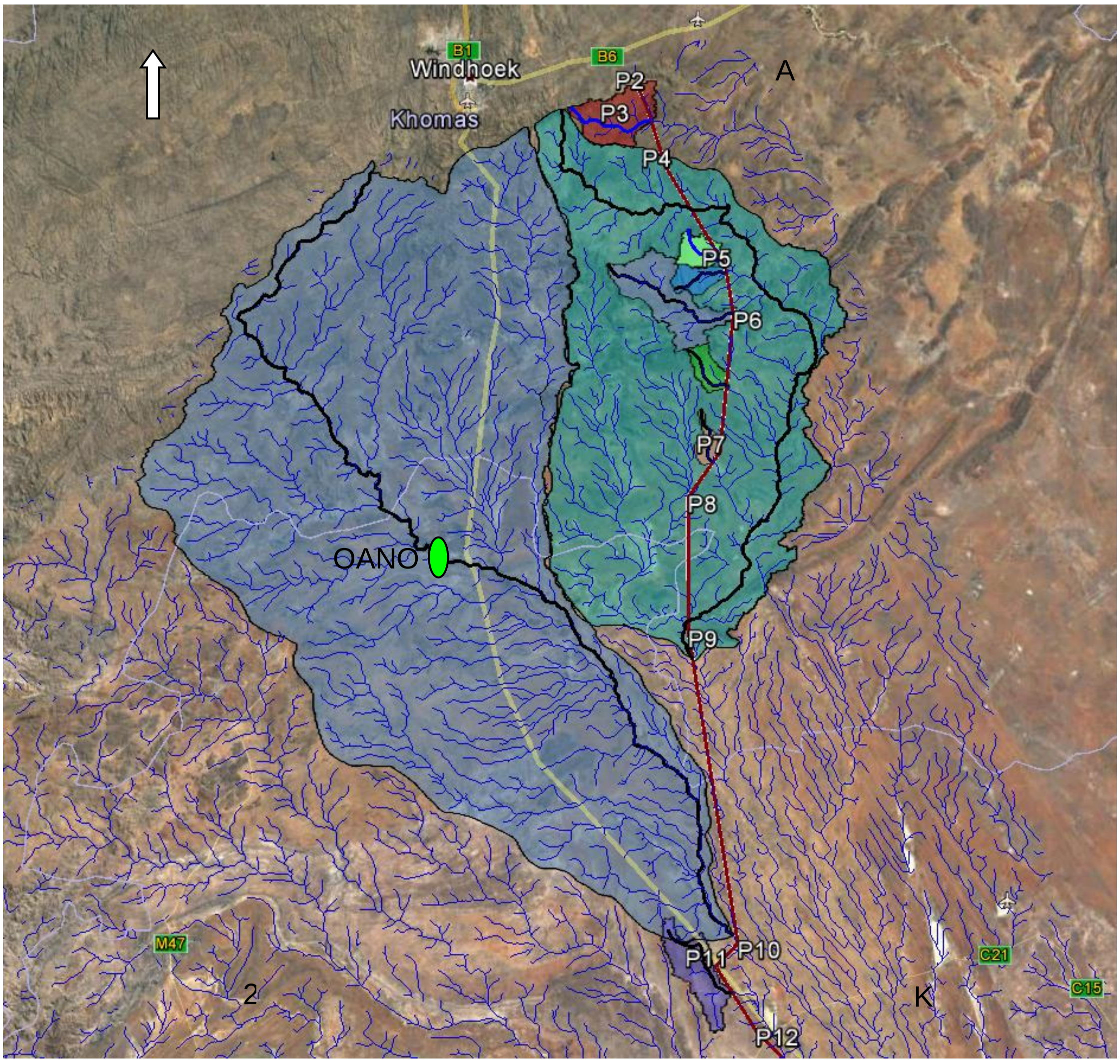

Figure 2.5: Drainage – Section 3

2.4 The Receiving Environment

The elements of the environment around which this study is centred are essentially the catchment areas and the streams which they feed. Run-off with return periods of 50 and 100 years were calculated and the flood levels for the larger catchments were estimated. The proposed transmission power line is expected to have little impact on the environment as it relates to this specialist study. The impacts of the environment on the project will be more significant. In this context the habitat is able to withstand significant disturbance without a marked impact on its biodiversity. The affected environment could thus be categorised as having a high tolerance to disturbance from the envisaged infrastructure.

The floodline assessment will assist in ensuring that the power line route is selected and optimised taking into consideration the preliminary route identified. The study will also identify the most practical and economically viable management, mitigation and monitoring measures.

It is not expected that there will be long term cumulative impacts of the power lines running parallel to each other on the run-off and drainage of the catchments.

2.4.1 Land use

The Project area can be described as bush veld savannah and is dominated by commercial stock farming, mostly on private land. Further to the north, large stock farming is dominant while small stock is more prevalent in the south. Commercial game farms are also encountered.

3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

NamPower proposes to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km. There are existing 400 kV and a 220 kV transmission lines connecting the two substations but these follow a slightly different route. The final transmission line servitude will be 80 m in width, with 12 m of that being cleared for an access track.

The alignment of the proposed transmission line corridor runs south from the Auas Substation and then parallel to the 220 kV transmission power line from Kalkrand southwards. It will exit the existing Auas Substation in a southerly direction and enter the existing Kokerboom Substation from the north.

The proposed transmission power line traverses 3 regions, namely the Khomas, Hardap and //Karas Regions. There are six (6) potentially affected constituencies, the Windhoek Rural, Mariental Rural, Rehoboth Rural, Gibeon, Berseba and Keetmanshoop Rural constituencies.

The infrastructure proposed includes a 400 kV transmission line conductor strung onto 45 m high steel pylons, of the Open-V or the Self-Supporting design, placed approximately 500 m apart. These pylons will be placed on a 10 m by 10 m concrete base. The line needs to be at least 100 m away from the existing 220 kV power line.

The proposed construction work to be carried out includes:

- Site establishment, including site demarcation and fencing (temporary and only where required), layout and establishment of the Contractor's Camps including ablution and cooking facilities (this will only be established if required by the appointed Contractor)
- Transportation of plant, machinery and equipment to site
- Construction of the access road.
- Digging of holes for the concrete pylon base
- Casting of concrete platforms for the pylons
- Transport of the conductor into position by means of a pulley system or by rolling large coils of conductor into position
- Hoisting and lifting of the pylons into position and
- Stringing of the conductor.

The transmission power line will take approximately 24 months to construct, depending on whether one or more Contractors are appointed to undertake the work and/ or there are one or more working fronts.

Prior to construction, a final 'walkdown' of the proposed centreline of the transmission power line corridor alignment will be undertaken and the sites of each of the pylons finalised and demarcated. During final positioning of the pylons, sensitive features (e.g. plant habitats, drainage lines and archaeological sites) will be avoided.

An Environmental Management Plan (EMP) for the construction and operational phase will be compiled. This EMP will be included in the tender documentation and the Contract with the appointed Contractor(s). It will contain all the mitigation measures/ management actions proposed in this EIA process and will be included in draft format in the Assessment Report, which will be compiled in the next phase of this EIA.

NamPower has operated the existing 400 kV and 220 kV transmission power lines between the Kokerboom and Auas Substations for the past 16 and 17 years, respectively. The operation of the power line will be a continuation of the *status quo* operational and maintenance activities, namely:

- Site inspections, including Technical and Safety, Health, Environment and Wellness (SHEW)
- Power line housekeeping
- Vegetation management, including herbicide application and manual vegetation clearing
- Maintenance of the powerline and repair of the access roads

The above construction and operational activities formed the development 'proposal' (referred to as the proposed Project) as assessed in the EIA process.

3.1 Alternatives

A number of alternatives ('no-go', technology, methods of construction and operation, equipment, and mitigation measures) to the construction and operation of the transmission power line were considered by NamPower and assessed during the EIA process.

The 'no-go' alternative is not recommended given the national importance of the Kokerboom to Auas transmission line in power supply to Namibia. The demand for power is continually increasing as a result of population expansion, diminishing power supply from Namibia's neighbouring countries, as well as residential, mining, agricultural and industrial development. The existing 400 kV and 220 kV power lines cannot cope with the expected power transmission requirements into the future. It is predicted that a new power line will need to come on line as part of the overall transmission line system within the next 6 to 10 years. Should the Kudu Gas Project come on line earlier than expected then the transmission power line will be required even earlier.

Three alternative power line corridors were assessed as part of the EIA. Each alternative was scoped and a new alternative put forward for assessment that avoided potential negative biophysical as well as socio-economic impacts. The power line corridor is 250 m either side of the centre line.

The technical specialists although involved in the scoping of the power line corridor alternatives only assessed the ‘favoured’ alternative in detail. The preferred corridor alignment avoided sensitive environmental features, most notably sensitive perennial pans, an avifauna hotspot and social infrastructure such as landing strips, recreational areas, homesteads, towns, villages etc.

In sourcing the specific equipment for the proposed transmission line, NamPower will assess alternatives in terms of availability, efficiency, compatibility with the existing equipment, cost and environmental sustainability, before making a final decision.

Operational alternatives are limited as NamPower already has an operational protocol for the 400 kV and 220 kV power lines between the Kokerboom and Auas Substations, as well as its other transmission lines, which is being implemented satisfactorily. Operational procedures will be a continuation of the *status quo,* as new operational procedures are considered unnecessary by NamPower given that the current ones are tried and tested and considered effective, efficient and sustainable.

4 HYDROLOGY

4.1 Hydrology Investigation

This task describes the methodology employed to determine the flood flows for the rivers that cross the Kokerboom Auas Transmission line. These flows were determined in accordance with the requirements of the Namibian Drainage Manual.

The objective of the hydrological investigation is to determine the flood hydrology with probabilities of exceedance of 5%, 2% and 1% (1 in 20, 1 in 50 and 1 in 100 year flood events) along all the drainage paths of the rivers and streams that cross the proposed power line.

4.2 Available information

The following sources of information were consulted as part of this task:

- Topographical information in the form of route maps, aerial photographs, existing digital terrain models and contours that cover the catchment areas as well as the satellite photos available on Google Earth;
- Long term rainfall records (daily) in the Windhoek and Rehoboth areas, obtained from the Namibia Meteorological Service;
- Existing reports on the hydrology of the Fish River;
- Long term flow records of the gauging station in the Arebbusch River at Monravia (daily) obtained from the Department of Water Affairs of Namibia.

4.3 Assumptions

The following important assumptions were made at the onset of this task:

- All relevant available rainfall and flow records made available by either the Department of Water Affairs or Namibia Meteorological Service are the best information available;
- The rational method (deterministic) would be the main method of determining the flood peaks.

- For the rational method the smallest storm duration to be considered for a particular catchment will be equal to the time of concentration of that catchment to ensure runoff contribution from the entire catchment;
- The results of the statistical analysis of the available flow gauging records at the Monravia gauging station will be used as a comparison and used to calibrate the Rational Method coefficients;
- The rainfall events used in the analyses take place at the same time over the full extent of the relevant catchment;

4.4 Methodology

The following methodology was used for the hydrological evaluation:

- All the existing relevant meteorological and hydrological information was sourced from either the Department of Water Affairs (DWA) or Namibia Meteorological Service (NMS) and included the following:
    - Daily rainfall records from the Namibia Meteorological Service. It is important to note that of the 8 stations considered, only 2 of the stations had record lengths longer than 15 years;
    - Long-term daily flow records of gauging station 2982M06 in the Arebbusch River at Monravia (daily) (1983/84 to 2010/11- 28 year record)
    - Flow records and rainfall data for the Oanob River
    - Flow records and rainfall data for the Fish River.

- A site visit of the study area was not conducted. The author of the report is familiar with the catchment conditions along the power line route for the level of detail required.
- The catchments of the rivers were determined from the available topographical information, an existing 20 m x 20 m DTM of the study area, aerial photography and the satellite images on Google Earth.
- The catchment characteristics were also determined from the available topographical information. These characteristics include the longest watercourse, the effective catchment area, the time of concentration (t_c), the mean catchment slope (S_L) using the Taylor-Schwartz method (NERC: 1975) (including varying C_y values due to varying steepness percentages), the land surface cover (grass land – C_v of 0.17) and the permeability of the soil (impermeable – C_p of 0.21);
- The rainfall records were statistically analysed and the relevant storm rainfall records were determined.

- The maximum annual daily rainfall depths for 1 day, 2 days, 3 days and 7 days as well as the Mean Annual Precipitation (MAP) were determined from the records. These annual daily rainfall values were converted to a storm duration of the time of concentration by converting the daily values to hourly values and interpolating between the hourly rainfall depths. The annual daily depths were also statistically analysed to obtain storm rainfall for exceedance probabilities of 0.5%, 1%, 2%, 5%, 10%, 20% and 50%.
- In the statistical analysis the Cunane plotting positions were used. (The Cunane plotting position is very close to the average of the Gringorten and Blom plotting positions). The following probability distributions were evaluated:
  - Log Normal (LN) distribution;
  - Log Pearson III (LP3) distribution; and
  - General Extreme Value (GEV) distribution.
- The Cunane plotting position can be calculated as follows:

$$P_T = \frac{(m - 0.4)}{(N + 0.2)}$$

Where

- P_T = probability of exceedance;
- m = rank number of observed value; and
- N = total number of observations.

- The rational method (deterministic) was used to calculate the flood peaks with probabilities of exceedance of 5%, 2% and 1% for each catchment with a storm duration of each catchment's time of concentration (t_c).
- The flow record from the Monravia gauging station (2982M06) was statistically analysed including a probabilistic distribution analysis using graphical representation. The same method used for the statistical analysis of the rainfall records was also used for the analysis of this flow record including Cunane plotting positions and the following probability distributions: Log Normal (LN) distribution, Log Pearson III (LP3) distribution; and General Extreme Value (GEV) distributions. The flood peaks for the Monravia catchment with probabilities of exceedance of 0.1%, 0.5%, 1%, 2%, 5%, 10%, 20% and 50% were determined;
- The results of the statistical analysis were compared to the results obtained from the rational method for the same Monravia catchment to determine the practical relevance of the results obtained with the rational method (also to determine if all the chosen catchment characteristics are realistic).
- The results were analysed and the coefficients used in the Rational Method were calibrated using the results from the Monravia gauging station.

4.5 Flood peaks - Rational Method

A summary of the results of the flood peak determination with the Rational Method are given in **Table 4.1** for probabilities of exceedance of 2% and 1% respectively and for storm durations of the actual time of concentration of each catchment.

Table 4.1: Flood Peaks for Catchment Areas

Catchment name	River length (km)	Total area (km^2)	Time of concentration (h)	Av Slope	Area Reduction Factor (ARF)	I (intensity mm/h)	Q = 20 (m^3/s)	Q = 50 (m^3/s)	Q = 100 (m^3/s)
C1	16.59	107.7	2.90	1.45%	92%	24.93	126.3	168.2	202.6
C2	40.40	458.8	7.90	0.67%	88%	10.00	215.7	287.4	346.1
C3	155.25	3,476.5	27.40	0.39%	81%	2.99	489.5	652.1	785.4
C5	9.21	36.9	2.40	1.30%	97%	30.58	53.2	70.8	85.3
C6	28.40	156.2	5.30	0.91%	92%	15.05	110.6	147.3	177.4
C7	10.44	35.5	2.30	1.75%	97%	31.67	52.90	70.50	84.80
C10	11.48	35.1	2.20	2.63%	97%	32.80	54.10	72.10	86.90
C13	10.66	22.3	3.80	0.65%	100%	21.74	22.80	30.40	36.60
C16	210.26	7,171.5	33.80	0.35%	77%	2.30	776.5	1,034.6	1,246.0
C18	18.63	100.5	6.10	0.27%	95%	13.85	65.50	87.30	105.10
C19	49.60	321.5	12.80	0.28%	92%	6.88	104.00	138.60	166.90
C20	23.68	150.4	6.60	0.36%	94%	12.54	88.70	118.20	142.40
C21	33.40	543.2	7.30	0.55%	86%	10.82	276.40	368.30	443.50
C22	49.40	383.5	16.30	0.15%	92%	5.56	100.30	133.60	160.90
C23	15.46	71.0	5.60	0.28%	97%	15.11	50.50	67.20	81.00
C24	16.57	179.3	4.20	0.59%	91%	18.06	152.30	202.90	244.40
C25	34.60	234.1	8.20	0.45%	92%	10.27	113.00	150.60	181.40

The significant catchments are shown in **Figure 4.1**.

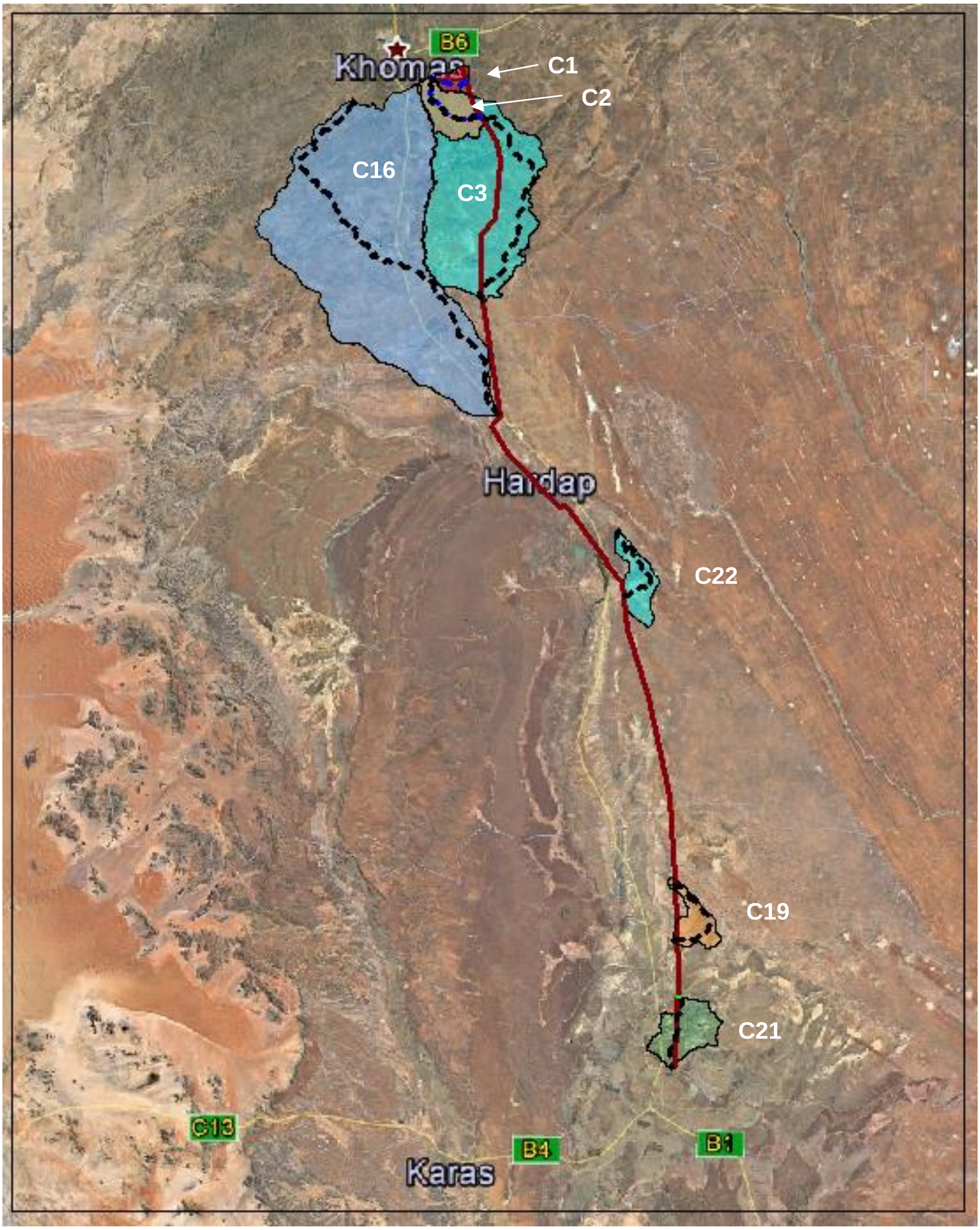

Figure 4.1: Significant catchments between Auas and Kokerboom

5 METHODOLOGY OF THE FLOODLINE ASSESSMENT

5.1 Hydraulic Modelling

Flood levels for the significant catchments were generated using the HEC-RAS River Modelling Software. This is a one-dimensional model which uses a backwater analysis and was developed by the U.S. Army Corps of Engineers (Hydrologic Engineering Center). With this software, a one dimensional model is built by importing a series of cross sections along the canal. Information such as the distance between cross-sections, position of the river bank stations and Manning's roughness values (n) form part of the required inputs to the model.

5.2 Methodology

The hydrology study identified all the streams that cross the powerline route as well as their catchments. The flow from each catchment was estimated using the Rational Method. These results are presented in **Table 4.1**.

For selected catchments a river analysis was carried out. Flood levels and floodlines for the 1 in 50 and 1 in 100 year return periods were generated for the selected streams at the points where they cross the powerline route. The catchments are shown in **Figure 4.1**. The estimated 1 in 100 year floodline was plotted for the significant catchments.

5.3 Available Data

The survey data that was used for the river analysis was a DTM with a 20 m grid, together with the aerial photographs of the route. The centre lines of the rivers were digitised from the aerial photographs and the river cross sections were generated using the 20 m DTM.

5.4 Constraints

The accuracy of the cross sections determines to a large extent what the accuracy of the flood study will be. In the study it was found that the bed of the river is not well defined in the DTM. This would have a significant effect on the flood levels at low flows. However, at higher flows such as the 1 in 100 year flow where the flood tends to extend outside of the riverbed and into the flood plain, the effect is not as marked. For the purposes of this study the accuracy will be acceptable. This takes into account that the width of the flood where it crosses the power line will not be near as wide as the distance between pylons of 500 metres.

5.5 Results for Transmission Line – Section 1

Five catchments of interest drain towards and cross the powerline route. They are shown in **Figure 5.1**. The catchment characteristics are shown in **Table 5.1**. The only catchment that poses a flood risk is Catchment no. 21. The estimated 1 in 100 year floodline is shown in **Figure 5.2**.

Table 5.1: Catchment characteristics – Section 1

Catchment No.	River length (km)	Total area (km^2)	Level (85%)	Level (10%)	Difference	Time of concentration (h)	Av slope	Q = 20	Q = 50	Q = 100
C19	49.60	321.57	1,105.7	999.90	105.81	12.80	0.28%	104.00	138.60	166.90
C20	23.68	150.46	1,052.1	988.26	63.87	6.60	0.36%	88.70	118.20	142.40
C21	33.40	543.20	1,151.7	1,014.8	136.90	7.30	0.55%	276.40	368.30	443.50
C24	16.57	179.33	1,167.9	1,095.1	72.89	4.20	0.59%	152.30	202.90	244.40
C25	34.60	234.18	1,135.0	1,019.3	115.65	8.20	0.45%	113.00	150.60	181.40

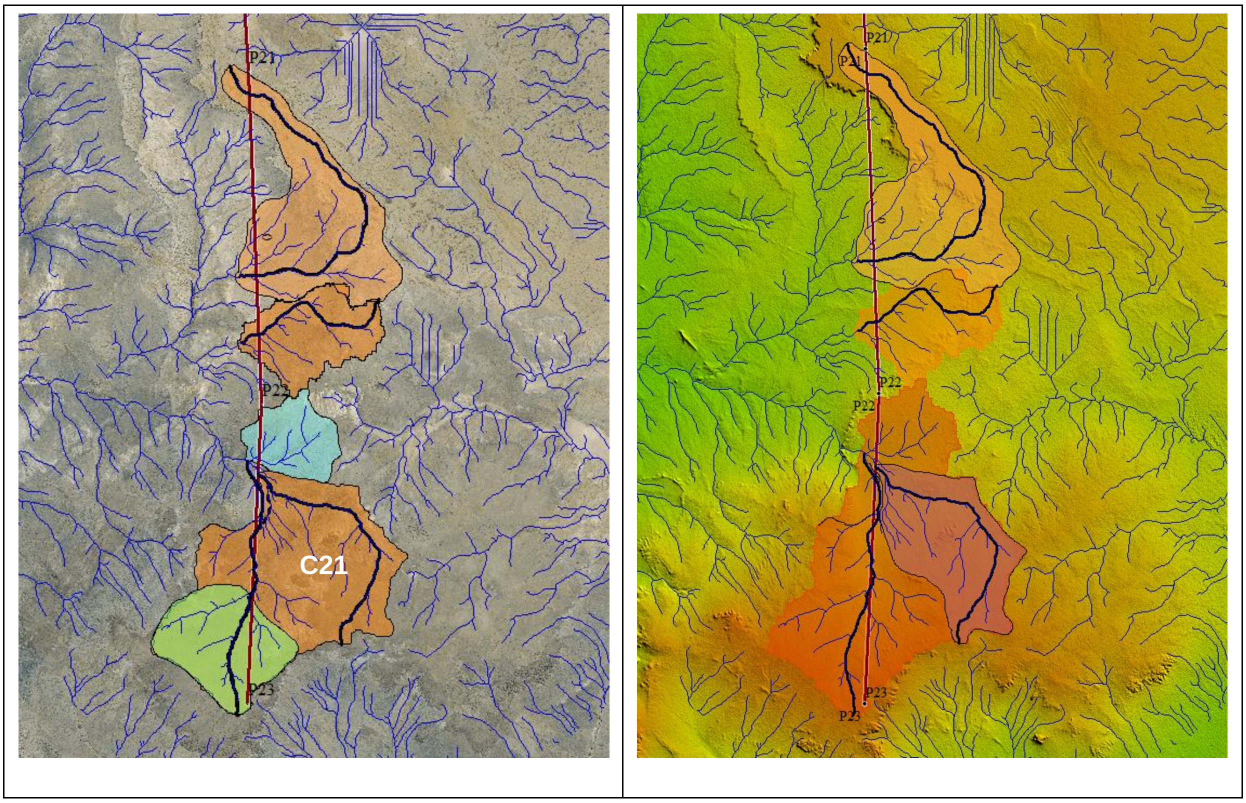

Figure 5.1: Drainage – Section 1

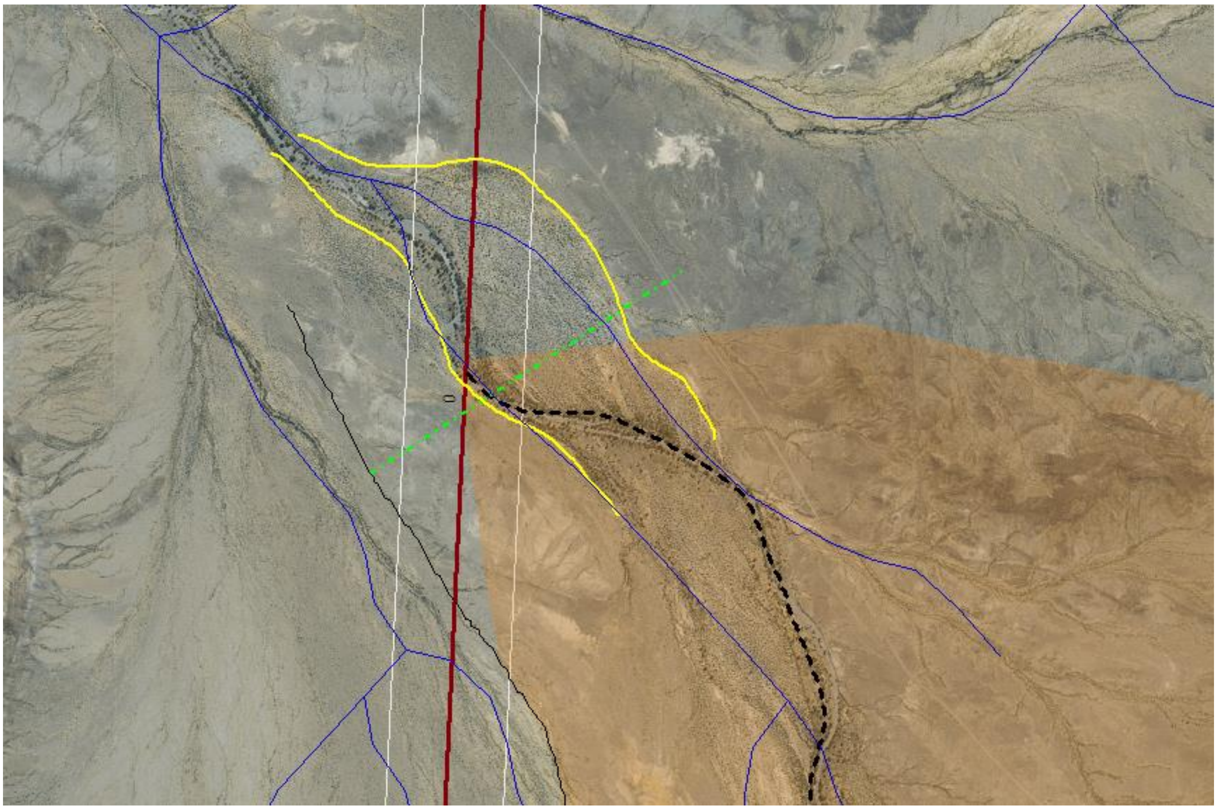

Figure 5.2: Estimated 1 in 100 year floodline – Catchment 21

The river cross section along the green line in **Figure 5.2** can be seen in **Figure 5.3** below.

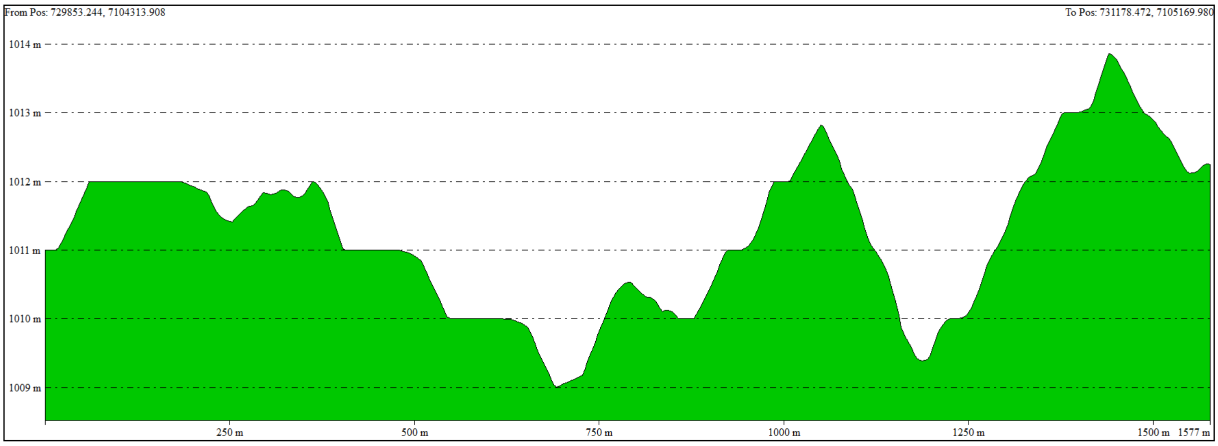

Figure 5.3: River cross section at the drainage point

At the point where the river crosses the powerline it forms a delta and the flow is split between a few streams. This can be seen in **Figure 5.3**. Although the potential flooded area is wide at this this point, a number of islands have formed where pylon bases can be constructed with minimal risk of flooding.

5.6 Results for Transmission Line – Section 2

Two catchments of interest drain towards and cross the powerline route. They are shown in **Figure 5.4**. The catchment characteristics are shown in **Table 5.2**. The only catchment that poses a flood risk is Catchment no. 22. The estimated 1 in 100 year floodline is shown in **Figure 5.5**.

The powerline runs along the watershed of the Fish and Aub Rivers for most of Section 2. There as thus very few catchments of which Catchment C22 is the only significant one. Refer to **Figure 5.4**. The estimated 1 in 100 year floodline is shown in **Figure 5.5**

Table 5.2: Catchment characteristics – Section 2

Catchment No.	River length (km)	Total area (km^2)	Level (85%)	Level (10%)	Difference	Time of concentration (h)	Av slope	Q = 20	Q = 50	Q = 100
C22	49.40	383.5	1,207.2	1,151.2	55.93	16.30	0.15%	100.30	133.60	160.90
C23	15.46	71.0	1,192.0	1,159.3	32.68	5.60	0.28%	50.50	67.20	81.00

.

Figure 5.4: Catchments - Section 2

Figure 5.5: 1 in 100 year Floodline – Catchment C22

It can be concluded that no flooding is expected on Section 2.

5.7 Results for Transmission Line - Section 3

The ten catchments that drain across the powerline route are shown in **Figure 5.6**.

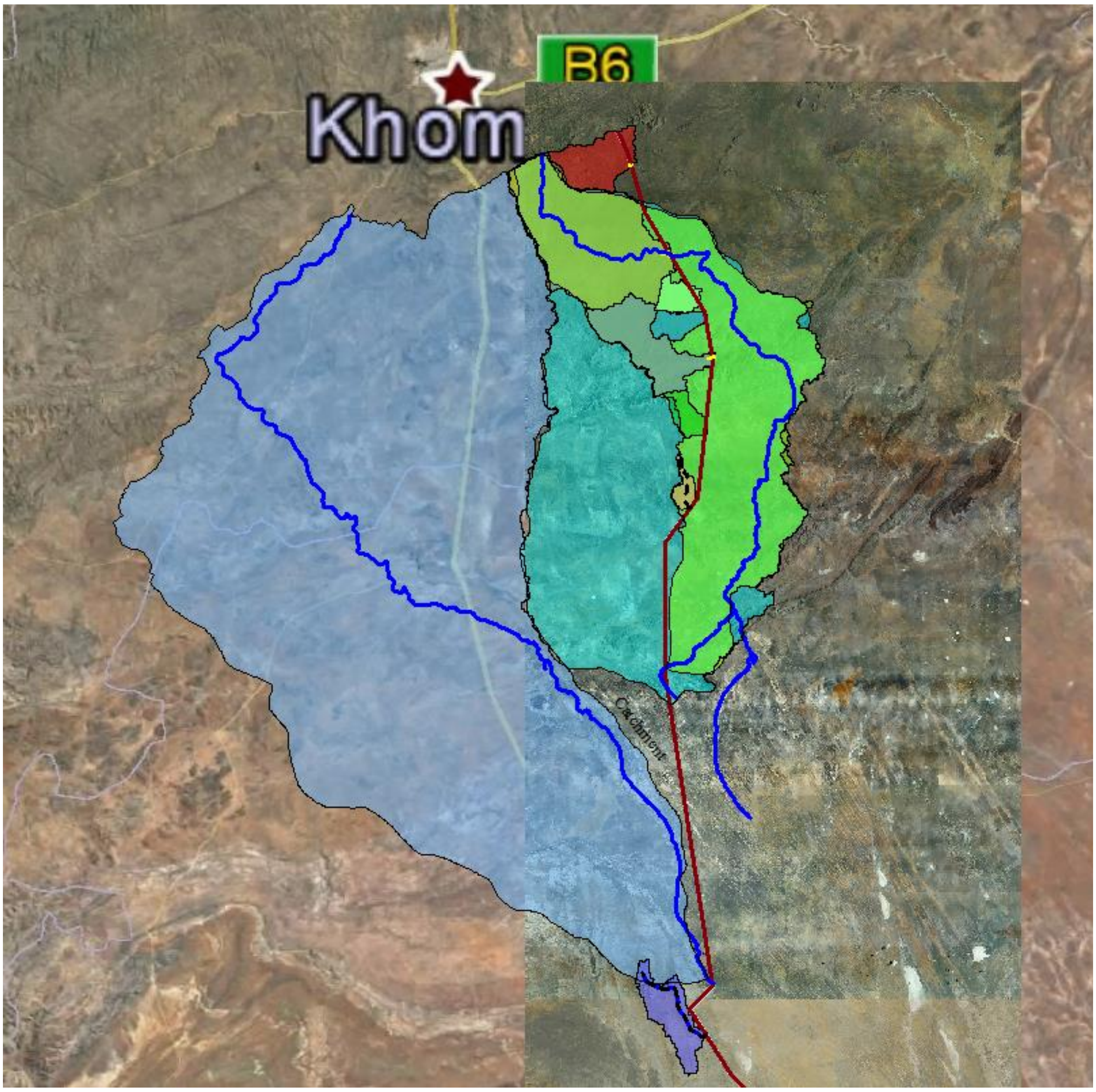

Figure 5.6: Catchments in Section 3

The catchment characteristics for the above catchments are provided in **Table 5.3**.

Table 5.3: Catchment characteristics – Section 3

Catchment name	River length (km)	Total area (km^2)	Time of concentration (h)	Av Slope	Area Reduction Factor (ARF)	I (intensity mm/h)	Q = 20 (m^3/s)	Q = 50 (m^3/s)	Q = 100 (m^3/s)
C1	16.59	107.7	2.90	1.45%	92%	24.93	126.3	168.2	202.6
C2	40.40	458.8	7.90	0.67%	88%	10.00	215.7	287.4	346.1
C3	155.25	3,476.5	27.40	0.39%	81%	2.99	489.5	652.1	785.4
C5	9.21	36.9	2.40	1.30%	97%	30.58	53.2	70.8	85.3
C6	28.40	156.2	5.30	0.91%	92%	15.05	110.6	147.3	177.4
C7	10.44	35.5	2.30	1.75%	97%	31.67	52.90	70.50	84.80
C10	11.48	35.1	2.20	2.63%	97%	32.80	54.10	72.10	86.90
C13	10.66	22.3	3.80	0.65%	100%	21.74	22.80	30.40	36.60
C16	210.26	7,171.5	33.80	0.35%	77%	2.30	776.5	1,034.6	1,246.0
C18	18.63	100.5	6.10	0.27%	95%	13.85	65.50	87.30	105.10

Four significant catchments were identified in Section 3 and these are shown in **Figure 5.7**.

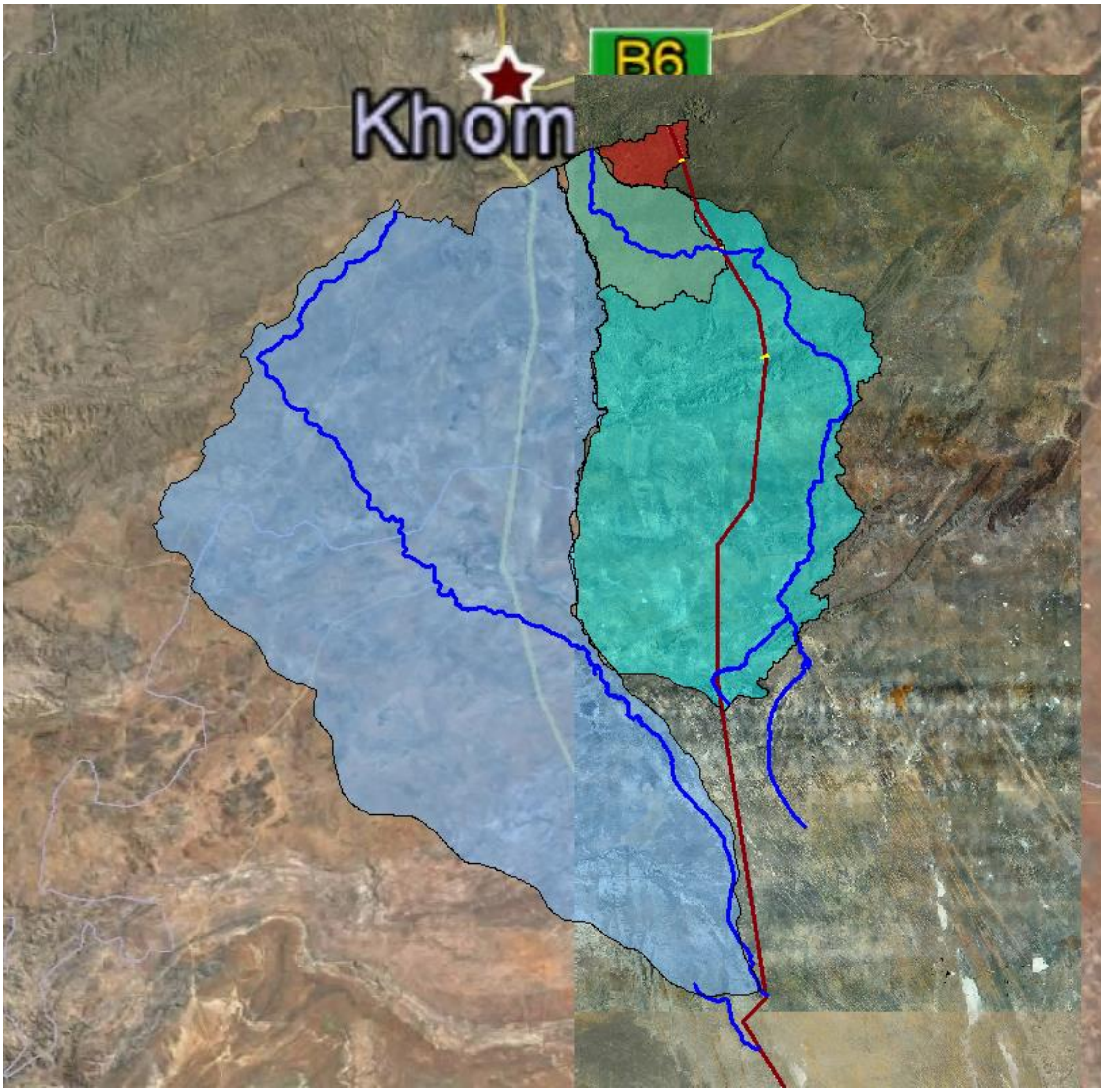

Figure 5.7: Significant Catchments – Section 3

5.7.1 Floodline for Catchment 1

Catchment 1 has an area of 108 km^2 and the estimated 1 in 50 and 1 in 100 year flows area 168 and 203 m^3/s respectively.

The estimated 1 in 100 tear floodline is shown in **Figure 5.8**.

Figure 5.8: Catchment 1 – Estimated 1 in 100 year Floodline

The width of the flood at the powerline crossing is approximately 100m. This does not pose a flood risk to the powerline.

5.7.2 Floodline for Catchment 2

Catchment 2 has an area of 460 km^2 and the estimated 1 in 50 and 1 in 100 year flows are 287 and 346 m^3/s respectively.

The estimated 1 in 100 tear floodline is shown in **Figure 5.9**.

Figure 5.9: Catchment 2 – Estimated 1 in 100 year Floodline

The powerline runs parallel to the river for approximately 1 km. Over a substantial distance the powerline route runs within the flood zone of the river. The placing of the pylons in this area is crucial to ensure that they are placed outside the flood zone.
With the correct mitigating measures, the flood zone will not pose a risk to the powerline.

5.7.3 Flood Risk from Catchments 3 and 16

The significant catchments in Section 3 are shown in **Figure 5.7**. Included in these are Catchments 3 and 16 which, of all the catchments draining across the powerline route, have by far the highest flows when using the Rational Method described in the Hydrology Section of the report. The 1 in 100 year flows of these two catchments are 785 and 1 246 m^3/s respectively.

Catchment 3 is drained by the Skaap River which can be seen in **Figure 5**.7, while the Oanob River can clearly be seen where it drains Catchment 16. These rivers are very active in their upper reaches, however, as they enter the sandy Kalahari their water seeps into the sand. In fact, the entire Oanob and Skaap rivers vanish into a series of pans between Tsumis and Uhlenhorst, and are not directly linked to the main Auob riverbed. The Auob starts up again about 60 km further south, between Uhlenhorst and Stampriet.

With reference to **Figure 5.7**, the defined river channels start to disappear where the blue lines end. Images of these areas are provided in **Figure 5.10** and **Figure 5.**11.

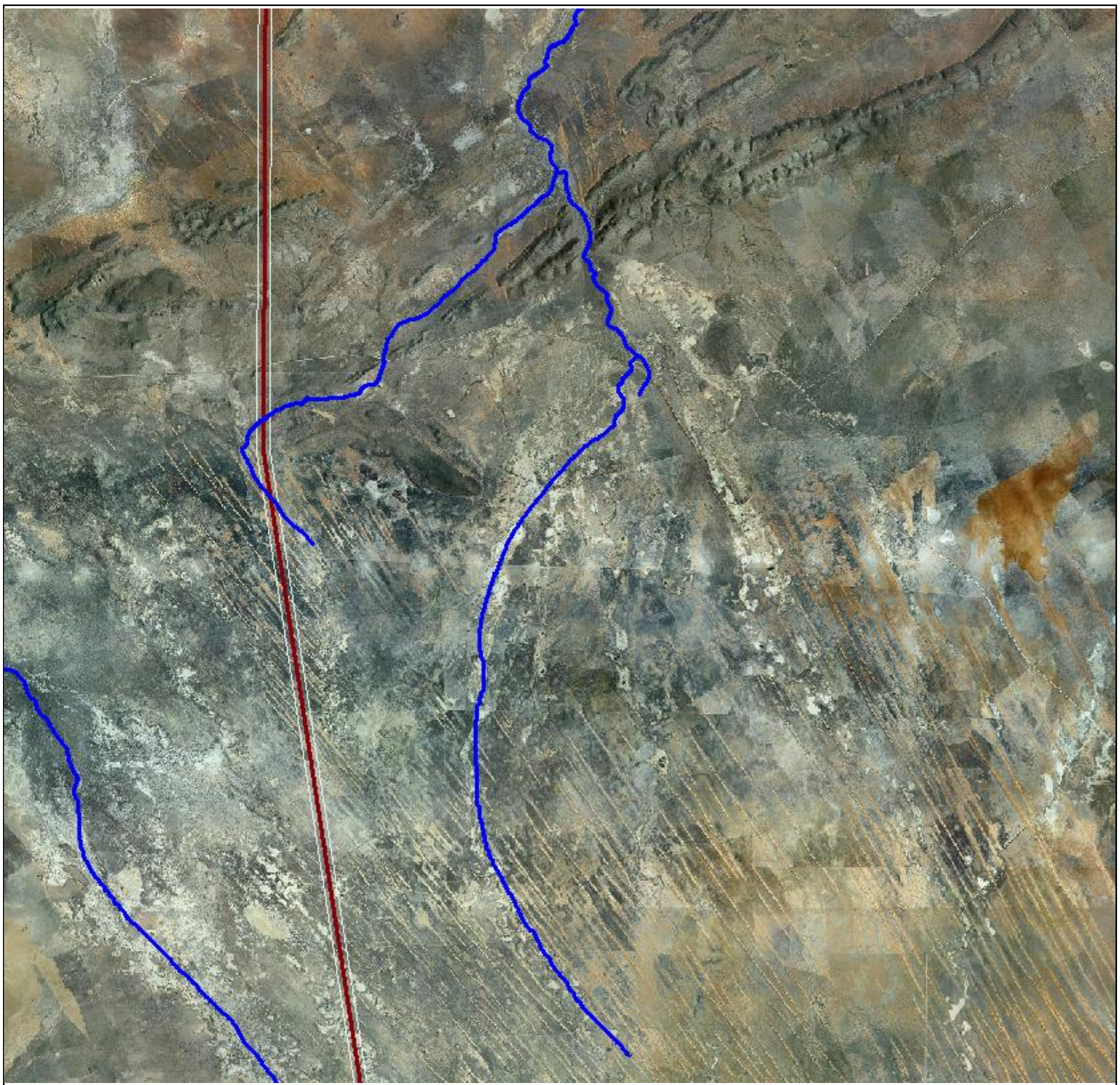

Figure 5.10: Skaap River where it disappears into the sandy Kalahari

Figure 5.11: Oanob River where it disappears into the sandy Kalahari

These rivers therefore do not pose a flood risk to the powerlines.

6 ASSESSMENT OF POTENTIAL IMPACTS

NamPower identified the transmission line corridor alignment in consultation with the directly affected land owners, key stakeholders, and with input from the environmental consultants, relevant specialists and registered Interested and Affected Parties. The screening of corridor alignments and the development of a “preferred” alignment has already served to avoid and reduce potential negative impacts of the proposed project and on the hydrology of the receiving environment.

When considering the impacts of the powerline construction on the drainage network the impacts will be localised and will be related to erosion within the channel due to construction of pylons in the stream and the construction of the access track which can disturb the normal flow within the stream.

When considering the impacts of the hydrological environment on the powerlines the impacts will be related to the erosion of the foundation of pylons placed within the flood zone of streams and damage to the access road from erosion by the floodwaters.

It is not expected that there will be long term cumulative impacts of the three power lines, and their associated access tracks, running alongside each other on the run-off and drainage of the catchments.

Mitigation measures are related to the protection of the pylon foundations where they cannot be located outside of rivers and streams, as well as the design of the access track to reduce the risk of erosion damage from stormwater runoff.

6.1 Identification of Potential Impacts

The potential impacts of the proposed project on the hydrology of the receiving environment are described in terms of the following criteria:

a) Nature of the impact
b) Extent of the impact
c) Duration of the impact
d) Intensity
e) Reversibility
f) Irreplaceability
g) Consequence
h) Probability of occurrence
i) Significance
j) Degree of confidence in predictions
k) Cumulative impacts.

The impacts will be further evaluated in accordance with the rating tables provided in **Section 6.3**.

6.1.1 Construction phase

The potential impacts in the construction phase will relate mainly to excavations required for the pylon foundations. This may require blasting and the disposal of surplus excavation material.

Construction activities, the movement of vehicles and the clearing and construction of the access track will require monitoring.

6.1.2 Operational phase

The potential impacts in the operational phase will relate mainly to monitoring of erosion following any stormwater runoff so that damage can be assessed and repairs effected.

6.1.3 Cumulative impacts

No cumulative impacts are foreseen.

6.2 Mitigation of Impacts

The basic principle of mitigation is to guide development to either avoid potential negative impacts or achieve the least possible negative impact on resources. Mitigation measures are designed to reduce the consequence or probability of an impact, or to reduce both consequence and probability.

Thus, field survey, documentation and evaluation of the hydrological sensitivity and flood levels are precursors of mitigation. The field survey and floodline analysis results not only inform the process towards mitigation but also serve as a basic record of the hydrology in the event of inadvertent impact. Where impact is an unavoidable consequence of development, full mitigation is required to comply with national laws, international guidelines and professional best practice standards.

The transmission line corridor route has already been altered to avoid potential environmental impacts. NamPower identified suitable routing options for the transmission line in consultation with a range of personnel from NamPower, and with input from the environmental consultants and relevant specialists. The realignment has already served to avoid and reduce potential negative impacts of the proposed project on archaeological and other environmentally sensitive areas/ receptors.

Mitigation will strive to achieve the following:

- Rectification: impact is mitigated after it has occurred e.g. rehabilitation of areas disturbed by construction and rehabilitation of eroded areas
- Compensation: providing a substitute resource for a resource that has been lost because of the project e.g. " offsets"
- No action (least preferred) and
- Enhancement: establish optimisation measures that will enhance the benefits of the positive impacts.

The proposed mitigation measures for implementation during the construction phase to reduce potential negative impacts are the following:

- Clear definition of the construction footprint
- Identification and pegging of the access route before commencement of construction work
- Placement of pylons out of all streams and drainage channels, where possible, and
- Where footings must, out of necessity, be placed in stormwater run-off channels they must be protected against erosion.

The proposed mitigation measures for implementation during the operational phase to reduce potential negative impacts are the following:

- Placement of pylons outside the flood zones, or
- Provision of erosion protection to pylon bases
- Construction of the access track along the profile of the stream bed and to ensure that it does not form an obstacle to flow in the stream bed.

These mitigation measures are to be incorporated in the project Environmental Management Plans for the construction and operational phases, and applied as necessary.

6.3 Impact Rating Tables

A rating table has been completed for each identified impact in each phase of the proposed project lifetime, without and with effective mitigation measures in place.

The table below outlines predicted environmental impacts on the hydrology during the construction phase.

Table 6.1: Construction Phase Impacts Without and With Mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Soil erosion:										
Impact Description: Soil erosion which will only occur when there is flow in the streams can be caused by two construction activities (i) the construction of the access track (ii) construction of pylon bases. Damage will only occur locally and will last as long as there is flow in the stream. In this area the period of flow is likely to be short.										
Without Mitigation	Erosion damage	Local	Short-term	Low	Easy	Not applicable	Minor	Probable	Low	High
Mitigation Description: Construction activities within the streams should be stopped for the duration of flow Construction equipment and materials must be stored outside the 1 in 100 year floodline										
With Mitigation	Reduced Erosion	Local	Short-term	Negligible	Easy	Not applicable	Negligible	Improbable	Low	High
Cumulative Impact: No cumulative impact is foreseen										

The table below outlines predicted environmental impacts on the hydrology during the operational phase.

Table 6.2: Operational Phase Impacts Without and With Mitigation

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Soil erosion:										
Impact Description: Soil erosion will only occur when there is flow in the streams can have two sources (i) the constructed the access track (ii) pylon bases constructed in the streams. Damage will only occur locally and will last as long as there is flow in the stream. In this area the period of flow is likely to be short.										
Without Mitigation	Erosion damage	Local	Short-term	Low	Easy	Not applicable	Major	Probable	High	High
Mitigation Description: Access track should be constructed with as little disturbance to the stream bed level as possible. The track surface should follow the stream bed level as closely as possible. Pylons must be placed outside the 1 in 100 year floodline. Where this is not possible the pylon bases must be designed to withstand erosion from flooding and be provided with flood protection. Without mitigation damage to pylons can be significant leading to high cost of repairs and power outages.										
With Mitigation	Erosion damage	Local	Short-term	Negligible	Easy	Not applicable	Minor	Probable	Low	High
Cumulative Impact: No cumulative impact is foreseen										

7 CONCLUSIONS AND RECOMMENDATIONS

The conclusions from this Floodline Assessment can be summarised as follows:

- There are some significant drainage catchments in the northern part of the proposed transmission line corridor that may affect the construction of the proposed power line.
- Approximately 300 km of the proposed transmission line corridor alignment will not be affected by flooding.
- The potential impact of floods on the proposed infrastructure is negligible if the proposed mitigation measures and management actions are implemented. Without mitigation the impact on the cost of repairs to pylons can be significant. Resulting power outages can have major downstream impacts on the Namibian economy.
- No negative impacts are foreseen during the construction and operational phases that cannot be effectively mitigated to an acceptable significance.
- Recommended mitigation measures during the construction phase include:
  - Stopping construction activities in the rivers when there is flow
  - Not storing equipment or materials in the 1 in 100 year flood zone of the river
- Recommended mitigation measures during the operational phase include:
  - Proper design and construction of the access track to ensure that it does not create an obstacle to the flow
  - Not constructing pylons in the flood zone of the rivers, alternatively if pylons have to be constructed within the flood zone
  - To provide proper erosion protection to pylon bases.

8 REFERENCES

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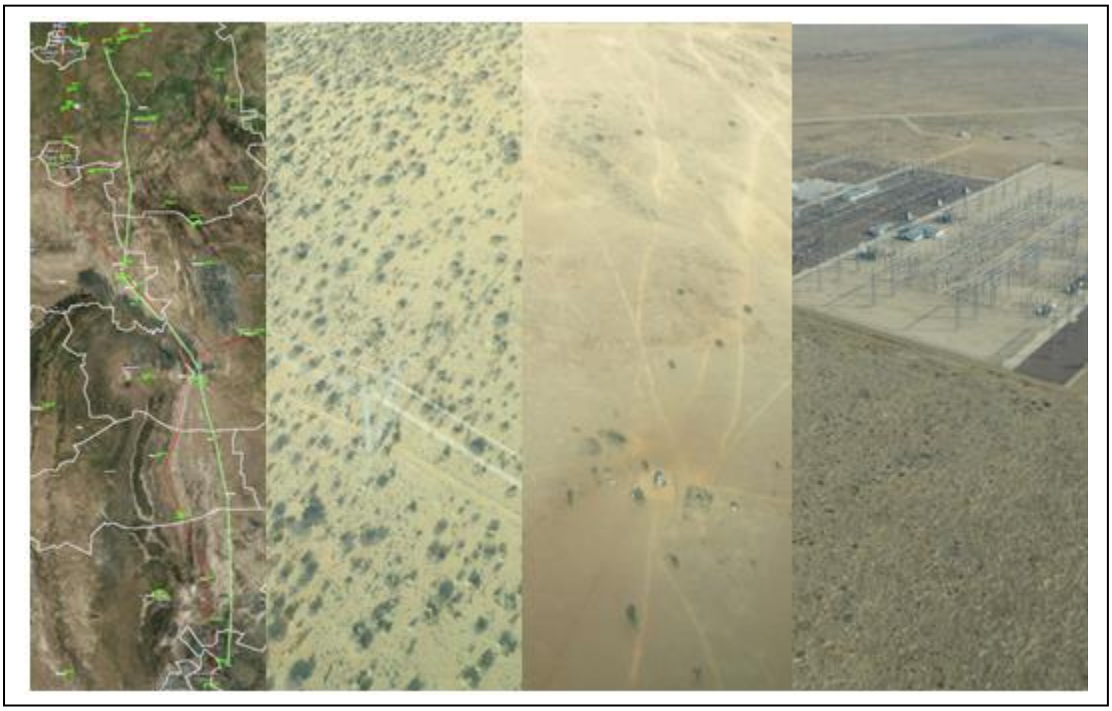
PROPOSED KOKERBOOM – AUAS 400 KV TRANSMISSION LINE

ENVIRONMENTAL IMPACT ASSESSMENT



Social Impact Assessment Report
For input into the Environmental Impact Report

Kerryn McKune Desai, MA Geography and Development

November 2016

Kerryn McKune Desai

13 April 2016

DECLARATION OF INDEPENDENCE

I, Kerryn McKune Desai, confirm my independence as a specialist and declare that I do not have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Lithon Project Consultants (Pty) Ltd was appointed to manage the Environmental Impact Assessment (EIA) process or Ms. Jaana-Maria Ball was appointed as Environmental Assessment Practitioner in terms of the Environmental Management Act, 2007 (Act No. 7 of 2007) and EIA Regulations, 2012, other than fair remuneration for work performed, specifically in connection with the EIA process for the proposed Kokerboom to Auas 400 kV transmission line. I further declare that I am confident in the results of the study undertaken and conclusions drawn as a result of such – within the limitations as are described in my attached report.

My *Curriculum Vitae* outlining my qualifications and experience is presented in Appendix 1.

Full Name:	Kerryn McKune-Desai
Title / Position:	Social Specialist
Qualification(s):	MA Geography and Development
Prof. Membership:	N/A
Experience:	15 years
Contact details:	+27 (0) 87 809 0839, kerryn@34degsouth.com

EIA FOR THE PROPOSED KOKERBOOM TO AUAS 400 KV TRANSMISSION LINE, NAMIBIA

SOCIAL IMPACT ASSESSMENT REPORT

EXECUTIVE SUMMARY

NamPower propose to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km. The pylon (tower) height will be approximately 45 m and the distance between pylons approximately 500m. There are two existing transmission lines connecting the two substations, a 400 kV and a 220 kV line but this infrastructure alone is considered inadequate to meet the future demand needs of the country. The purpose of the proposed Project is to strengthen the overall transmission network in Namibia. It is proposed that the line be constructed in approximately 5 - 10 years' time (i.e. before 2026), and possibly earlier if the Kudu Gas Project comes on line earlier than is currently expected. Without upgrades to the transmission line network future electricity supply will become constrained in Namibia, and as a result, restrict development (mining, industrial and residential) and negatively impact quality of life in the country as a whole.

This independent Social Impact Assessment (SIA) forms part of the full Environmental Impact Assessment (EIA) process undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966) and the EIA Regulations, 2012.

The proposed 400 kV transmission line traverses 3 regions (namely Khomas, Hardap and //Karas), and 7 constituencies (Windhoek Rural, Mariental Urban, Mariental Rural, Rehoboth Rural, Gibeon, Berseba, and Keetmanshoop Rural). Khomas region is one of the most densely populated regions of Namibia; it is home to the national capital, Windhoek. It is landlocked and centrally located in Namibia. Hardap and //Karas regions are geographically extensive regions with low levels of population density; large parts of these regions comprise the Namib and Kalahari deserts.

The Project area is defined by low population densities, high levels of poverty, relatively low levels of access to infrastructure, and poor quality rangelands (low carrying capacity is linked to the arid climate and poor agricultural practices, particularly along the southern section of the line). Livestock agriculture is the most dominant economic sector in the proposed Project area. The majority of the employed population derive income as employees (i.e. private, commercial agriculture and government). There are no formal settlements located within the proposed 500 m corridor. The area is used for grazing (domesticated livestock and game) and some eco-tourism and hunting activities. There are some private residences and tourist facilities located in close proximity to the proposed transmission line.

The transmission line route has been revised to avoid impacts on known existing infrastructure, as far as possible. NamPower identified a suitable routing option for the transmission line with input from the environmental consultants and relevant specialists. The realignment has served to avoid and reduce potential negative impacts of the proposed Project on socio-economic receptors (notably infrastructure).

This SIA considers the potential impacts of constructing and operating (including monitoring and maintaining) the proposed transmission line and its associated infrastructure (eg. access track) on the social and economic receptors within the 500 km and 500 m wide transmission line corridor.

The positive impact associated with the construction and operation of the proposed transmission line is the improved transmission network nationally. This impact may serve to enhance the economy as commercial and private electricity provision becomes more reliable and consistent potentially enabling business enhancements and a generally better quality of life. Some direct, indirect and induced employment opportunities will be created by the Project itself and through procurement spend. Benefits will be limited in the local area as the successful contractor (origin still to be determined through an open tender process) is likely to use skilled workers that are already known and trusted by them. Some short-term contract employment should be available to local people.

The negative impacts linked to the proposed Project will be localised and will affect land owners, land users and tourists in different ways. Existing agricultural activities will largely be able to continue unhindered during the construction and operation processes. Some planning will be required to minimise disruptions during construction. Tourism activities may be more sensitive to the construction phase nuisance factors and the visual intrusion of the line during the operational phase; these could impact on the sense of place for some receptors. Where the line is visible, specifically from private residences, some of the land owners and users may also experience a negative effect on sense of place. Not all tourists and land owners will respond in the same way to the existence of the line; local experience indicates that existing lines have not affected tourism or sense of place for most receptors.

The presence of transmission lines affects the ease with which helicopters/ gyrocopters (and similar aircraft) can fly over the farms. These aircraft are used by a small number of farmers as a means of managing farming activities. Flying becomes increasingly risky as a result of the lines due to low visibility and an inability to fly close to the ground in areas where lines are present. The addition of this proposed line will negatively affect farm management for some farmers.

The cumulative visual impact and hence the impact on sense of place, and the cumulative impact on disruption to farm management - resulting from the addition of the proposed transmission line - will exacerbate the already negative impacts experienced as a result of existing lines for some receptors.

Based on the Project information available and the socio-economic conditions, it is the reasoned opinion of the social specialist that the proposed Project should be authorised on condition that the stipulated mitigation measures are implemented.

EIA FOR THE PROPOSED KHURUB TO AUSSENKEHR 132 KV TRANSMISSION LINE, NAMIBIA

SOCIAL IMPACT ASSESSMENT REPORT FOR INPUT INTO ENVIRONMENTAL IMPACT REPORT

CONTENTS

TABLES

FIGURES

GLOSSARY OF TERMS, DEFINITIONS AND ABBREVIATIONS

Affected Environment/ Area	Those parts of the socio-economic and biophysical environment impacted on by development. Refer to Section 1.6.2 for more detail, as relevant to the Social Assessment.
Alternatives	A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited hereto: alternatives sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management, the so-called “no action” alternative may also require investigation in certain circumstances.
Assessment	The process of collecting, organising, analysing, interpreting and communicating data that are relevant to the decision.
Construction Activity	A construction activity is any action taken by the Contractor, his subcontractors, suppliers or personnel during the construction process.
Contractor	That main organisation appointed by the Developer, through the Project Manager (PM), to undertake construction activities on the site.
DEA	Directorate of Environmental Affairs
Developer/ Project Proponent	NamPower
EAP	Environmental Assessment Practitioner: Ms. Jaana-Maria Ball
ECD	Early Childhood Development
EC	Environmental Commissioner
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report; A report describing the process of examining the environmental effects of a development proposal, the expected impacts and the proposed mitigation measures.
EMP	Environmental Management Plan: The EMP for the project sets out general instructions that will be included in a contract document for the construction phase of the project. The EMP will ensure the construction activities are undertaken and managed in an environmentally sound and responsible manner.
Environment	Means the surroundings within which humans exist and that are made up of: a. The land, water and atmosphere of the earth. b. Micro-organisms, plant and animal life. c. Any part or combination of a) and b) and the interrelationships among and between them. d. The physical, chemical, aesthetic and cultural properties

	and conditions of the foregoing that influence human health and well-being.
Environmental Specifications (ES)	Instructions and guidelines for specific construction activities designed to help prevent, reduce and/or control the potential environmental implications of these construction activities.
EPC	Engineering, Procurement, and Construction
GDP	Gross Domestic Product
Gini Coefficient	The Gini coefficient indicates the level of concentration of wealth (0 being an equal distribution and 1 a totally unequal distribution).
I&AP(s)	Interested and Affected Party(s)
MET	Ministry of Environment and Tourism
Method Statement	A written submission by the Contractor to the Project Manager in response to the Specification setting out the plant, materials, labour, timing and method the Contractor proposes using to carry out an activity. The Method Statement shall cover applicable details with regard to: • Construction procedures. • Materials and equipment to be used. • Getting the equipment to and from site. • How the equipment/material will be moved while on site. • How and where material will be stored. • The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or solid material that may occur. • Timing and location of activities. • Compliance/ non-compliance with the Specifications. • Other information deemed necessary by the Project Manager.
NEEP	NamPower's Economic Equitable Policy
PPP	Public Participation Process
Project	This refers to all construction and operation activities associated with the proposed activities.
PM	Project Manager: Appointed firm responsible for overall management of the construction phase of the project including the management of all contractors.
Rehabilitation	Rehabilitation is defined as the return of a disturbed area, feature or structure to a state that approximates to the state (where possible) that it was before disruption, or to an improved state.
SIA	Social Impact Assessment
SS	Substation
TX	Transmission

1 INTRODUCTION

1.1 Background

This independent Social Impact Assessment (SIA) forms part of the full Environmental Impact Assessment (EIA) process (i.e. Screening, Scoping and Impact Assessment phases) undertaken and which the documentation emanating therefrom will be submitted to the competent authority, The Environmental Commissioner (EC): Ministry of Environment and Tourism (MET-DEA), for decision-making. The EIA is being undertaken in terms of the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966).

NamPower proposes to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km. There are two existing transmission lines connecting the two substations, a 400 kV and a 220 kV line. The pylon height will be approximately 45 m.

The EIA will assess the environmental acceptability of constructing, operating and maintaining a power line in the area with a length of approximately 500 km and width of 500 m (250 m from the centre line) and a final servitude of 80 m width, with 12 m of that being cleared for an access track. The access track will be used to bring in construction materials, as well as to access the power line and its associated pylons for maintenance purposes, throughout the infrastructure's life span. Emphasis was placed on the optimisation of route as well as cumulative impacts of numerous power lines on some of the Project affected farms. The EIA will not include the expansion of either of the two substations.

The proposed transmission line lies across three (3) regions (namely Khomas, Hardap and //Karas). Khomas is comprised of 10 constituencies with the capital being Windhoek. Hardap's capital is Mariental and comprises six (6) constituencies, and //Karas has six (6) constituencies with Keetmanshoop as the capital. Khomas region is one of the most densely populated regions of Namibia; it is home to the national capital, Windhoek. It is landlocked and centrally located in Namibia. South of Khomas is the Hardap region and south of Hardap is the //Karas region; both extend across Namibia (west to east) and together comprise southern Namibia. Hardap and //Karas regions are geographically extensive regions with low levels of population density; large parts of these regions comprise the Namib and Kalahari deserts.

The Project area is defined by low population densities, high levels of poverty, relatively low levels of access to infrastructure, and poor quality rangelands (low carrying capacity is linked to the arid climate and poor agricultural practices, particularly along the southern section of the line). Livestock agriculture is the most dominant economic sector in the proposed Project area. The majority of the employed population derive income as employees (i.e. private, commercial agriculture and government). There are no formal settlements located within the proposed 500 m corridor. The area is used for grazing (domesticated livestock and game) and some eco-tourism and hunting activities. There are some private residences and tourist facilities located in close proximity to the proposed transmission line.

The transmission line route has been revised to avoid impacts on existing infrastructure, as far as possible. NamPower identified a suitable routing option for the transmission line with input from the environmental consultants and relevant specialists. The realignment has served to avoid and reduce potential negative impacts of the proposed Project on socio-economic receptors (notably infrastructure).

This SIA considers the potential impacts of constructing and operating (including maintaining) the proposed transmission line and its associated infrastructure (eg. access track) on the social and economic receptors within the 500 km and 500 m wide transmission line corridor.

The SIA has been undertaken within the Impact Assessment phase of the EIA. Its main objectives are to present a description of the socio-economic environment, identify socio-economic impacts, assess impacts, and propose suitable enhancement and mitigation measures.

1.2 Study Objectives

The study's objectives are to present a description of the socio-economic environment, identify socio-economic impacts, assess impacts, and propose suitable enhancement and mitigation measures.

1.3 Report Content

The contents of the Social Impact Assessment is consistent with the requirements for specialist studies as set out in the Environmental Management Act, 2007 (Act No. 7 of 2007) and the EIA Regulations, 2012, and in summary contains:

- details and experience of the person who undertook the assessment and prepared the Report;
- description of the proposed activity and its alternatives;
- description of the potentially affected area;
- policy, legal and administrative/ institutional framework;
- methodology used as well as the assumptions and limitations of the study;
- description of the anticipated impacts;
- assessment of the potential impacts;
- methods and procedures for mitigating the potential impacts;
- description of cumulative impacts; and

- references.

1.4 Details of the Principal Parties

The Project Proponent is NamPower, a state utility, whose mandate is to generate, transmit and distribute power to users of power within Namibia.

The EIA process is being managed by Lithon Project Consultants (Pty) Ltd (hereafter referred to as Lithon) and the appointed Environmental Assessment Practitioner (EAP) is Mrs. Jaana-Maria Ball who is a registered Reviewer and Lead Practitioner with the Environmental Assessment Practitioners Association of Namibia (EAPAN). She prepared all the documentation emanating from this process.

This independent Social Impact Assessment was undertaken by Mrs Kerryn McKune-Desai to inform the authorities' decision to authorise the proposed development based on the identification and assessment of the potential impacts.

The contact details, expertise and experience as well as a Declaration of Independence are found at the start of the report (following the cover page). Her CV is provided in *Appendix 1*.

1.5 Scope of Work

The scope of work for the Social Impact Assessment is outlined below.

- Provide a socio-economic baseline description fit for purpose.
- Identify potential socio-economic impacts.
- Assess all potential positive and negative socio-economic impacts.
- Propose suitable enhancement and mitigation measures.
- Discuss the potential cumulative impacts.

1.6 Study Approach

1.6.1 Method

The SIA draws on the Social Scoping Report and takes into account additional information gathered and reviewed. The SIA report was researched and drafted between September and November 2016. The study approach is outlined below.

(a) Project Review and Information Analysis

All available secondary documents (see Section 6) were gathered for the project area and the project itself. This information was reviewed and relevant information extracted. Every effort was made to fill all gaps identified during the Scoping phase of the study. The types of secondary documents reviewed include:

- previous EIAs and associated annexures;
- a description of the project activities;
- maps and figures;
- national and local census reports;
- health reports;
- economic reports;
- comments from Interested and Affected Parties (I&AP) during the Public Participation Process (PPP); and
- studies for similar projects.

Numerous route alignments were presented to the project team and reviewed by all specialists (including social). Based on feedback the route was adapted to avoid social receptors, such as physical structures and cultivated land. This process was repeated numerous times until the most favourable route was identified.

(b) Site Visit and Primary Data Gathering

The social specialist, together with the Lithon Project Manager and NamPower representatives flew over the proposed transmission line route on 18 August 2015. Key informant interviews were undertaken with selected NamPower representatives. The objectives of the site visit and interviews were to:

- meet the project team and client;
- observe the project affected area;
- refine the area of influence in consultation with the project team and NamPower;
- verify secondary information gathered and address gaps identified; and
- gather additional secondary data and maps.

Feedback from the PPP was reviewed and incorporated into the SIA to inform the baseline description, impact identification, impact description, impact assessment, and formulation of mitigation/ enhancement measures. PPP was undertaken by means of public and focussed meetings with various stakeholders facilitated by the EIA Project Manager, and via written comments. Feedback received from Project stakeholders is provided in the EIA Report (Comments and Response Report).

Between September and November 2016, the Social Specialist undertook interviews with selected I&APs (telephonic and email) to follow-up on issues raised during the PPP. In addition, further information was gathered to better understand the Project area, issues and specific concerns.

(c) Impact Identification and Assessment

The identification, description and assessment of impacts and formulation of mitigation/ enhancement measures, drew on relevant secondary documentation, key informant interviews, scoping level PPP, project description provided and professional judgement of the social specialist.

Positive, negative, as well as cumulative impacts associated with the proposed Project have been identified. Impacts were assessed using the impact assessment methodology provided by Lithon to ensure that the assessment is comparable with the other specialist studies. The overall significance ratings were determined based on the result of a combination of the consequence of the impact and the probability of the impact occurring. Consequence is a combination of the extent, duration and intensity of the impact, as well as whether the impact is reversible or the affected resource irreplaceable. The methodology used to assess impacts is presented in *Appendix 2*. Impacts have been assessed for the construction and operation phases of the proposed Project[1].

Mitigation measures are proposed that aim to avoid, minimise or reduce adverse impacts. Assuming effective implementation of the measures, each impact was re-evaluated using the same assessment criteria to determine the significance of the residual impacts following mitigation.

1.6.2 Affected Environment/ Area

For the purpose of the Social Impact Assessment, the Project's indirect and direct areas of influence (hereafter referred to as the Project area), are described below and listed in **Table 1-1**, see *Appendix 2* for Locality Map.

- *Indirectly affected area*: The Project has the potential to generate national, regional and constituency level impacts. Some of the positive impacts may be experienced at the national, regional and constituency levels, while most of the negative impacts may affect a smaller area, most notably the constituency level. The line will pass within 20km of a number of towns; including (from north to south) Dordabis (~13.5km[2]), Duineveld (~1km), Kalkrand (~0.5km), Mariental (~7km), Kries (~1km), Amper-Bo (~3km) and Tses (16.5km).

- *Directly affected area*: The proposed transmission line corridor (500km x 500m) traverses ~89 farms (see *Appendix 2*). These farms will experience the most direct impacts and are therefore considered to represent the direct area of influence.

[1] The decommissioning phase is not part of the scope of this study given that NamPower rarely decommissions their transmission power lines. Should this happen it would take place after 30 plus years of operation.
[2] Distances were measured from the point in town closest to the proposed transmission line to the centre line.

Table 1-1 Proposed Project affected areas (north to south)

Indirectly Affected Area				Directly Affected Area
Country	**Region**	**Constituency**	**Closest Town/ Settlement**	**Farms**
Namibia	Khomas	Windhoek Rural	Dordabis	See *Appendix 2*
	Hardap	Mariental Rural	Mariental (Mariental Urban)	
		Mariental Urban	Mariental	
		Rehoboth Rural	Duineveld, Kalkrand	
		Gibeon	Kries, Gibeon, Amper-Bo	
	//Karas	Berseba	Tses	
		Keetmanshoop Rural	Keetmanshoop	

1.6.3 Assumptions and Limitations

The assumptions and limitations for the Social Assessment are outlined below.

- It was assumed that information provided by NamPower and Lithon was up to date, accurate, and that the technical specifications of the Project and site selection are in accordance with the relevant legislative and regulatory requirements.

- This Report and assessment depends on the legitimacy and accuracy of the secondary data, such as Census Data. The data was considered sufficient for the purpose of conducting the assessment.

- The opinions expressed by I&APs during PPP were provided by members of the public who attended the meetings and made verbal or written comment. These opinions are thus peoples' individual opinions and should not necessarily to be taken to represent the views of all the community members who are based in the Project area.

- The impact assessment is based on project information available and provided at the time of the study. Available Project information was limited and little information was available about employment, skills development and procurement. This will only be determined once the Engineering, Procurement, and Construction (EPC) Contractor is appointed.

- Selected land owners and land users were contacted and interviewed, not all details provided by the Deeds Office were correct and some land owners were unreachable. Despite numerous attempts to access the details for resettlement farmers from the respective regional authorities and the Ministry of Land Reform, this information was not forthcoming. The list of respondents is provided in Section 6.1.

- A site visit was undertaken during the Scoping Phase; selected follow-up interviews were performed telephonically and via email with key informants.

- Socio-economic impacts for the construction and operational phases of the project have been predicted and assessed. No assessment has been undertaken for possible decommissioning phase impacts.

- The social environment is dynamic and constantly adapts to changes. Often this makes it challenging to predict project specific impacts as if they happen in a vacuum, uninfluenced by pre-existing conditions.

1.7 Policy, Legal and Administrative Framework

The Social Impact Assessment has been developed in accordance with the Environmental Management Act (EMA; Act No 7 of 2007 gazetted on 27 December 2007 in Government Gazette No 3966), the EIA Regulations of 2012.

Other than the Environmental legislation and guidelines, there are no specific policies or Acts that will define the manner in which this work is undertaken. The Report is, however, aligned with the principles and commitments as outlined in The Constitution of the Republic of Namibia, of 1990, and draws on international best practice (International Finance Corporation Performance Standards of 2012) to inform social performance and practice.

The proposed Project affected area is located in rural farming areas; comprised largely of freehold and communal land. The revised Compensation Policy and Guidelines for Communal Land Areas in Namibia outlines circumstances where land is needed for public sector projects, provides direction on how to determine compensation for affected land and resources, and guides options for compensation. The proposed alignment of the transmission line is unlikely to directly affect individual communal land users as the route passes through degraded communal grazing land.

The Communal Land Reform Act 5 of 2000 regulates the powers of traditional authorities over communal land and establishes 12 regional communal Land Boards that control the allocation of customary land rights by the traditional authorities (eg, chiefs, headmen). The Land Boards grant, record, and cancel land rights in consultation with the traditional authorities[3].

The Traditional Authorities Act 25 of 2000 recognises traditional authorities as legal entities, provides for their designation as leaders, and defines their powers and duties. Traditional authorities have the obligation to supervise and ensure observation of customary law, to assist the local government with development of land-use plans, and to ensure that their communities are using natural resources in a sustainable fashion[4].

[3] Legal Assistance Centre (2005) in Property Rights and Resource Governance Profile: Namibia, 2010.
[4] Legal Assistance Centre (2005) in Property Rights and Resource Governance Profile: Namibia, 2010.

2 DESCRIPTION OF THE AFFECTED ENVIRONMENT

2.1 The Receiving Environment

2.1.1 Introduction

This Chapter describes the socio-economic characteristics of the potentially affected area in order to develop an understanding of the broad social and economic conditions of the environment. Drawing on this information, as well as lessons from similar developments and professional experience, the possible issues and impacts (positive and negative) associated with the construction and operation of the proposed Project will be identified. Each impact will be refined, described and assessed as part of the Impact Assessment Phase.

The proposed transmission line traverses three (3) regions (namely Khomas, Hardap and //Karas). Khomas Region is centrally located and landlocked; it has a population density of 9.3 people per km². Hardap has a low population density of 0.7 people per km². The //Karas Region is the most southern and largest region in Namibia, with an area of 161,215km²; it is the least densely populated of Namibia's 14 regions with only 0.5 people per km². The line passes through 6 constituencies, the majority of which are rural (see **Table 1-1**). The project's area of influence/ affected area is described in Section 1.6.2.

2.1.2 Administration and Organisation

Namibia has a three-tier system of governance comprising of central government, regional councils and local authorities; the Decentralisation Policy of Namibia was launched in 1998. The aim of decentralisation is to enable:

- economic, cultural and socio-economic development;
- broad public participation in decision-making; and
- democracy - based on National ideals and values[5].

Local authorities are established in urban areas and are responsible for service delivery. Municipal councils (2 types), town councils and village councils are responsible for governing the affairs of the local authorities. Regional councils are responsible for specified service delivery in rural areas. The 14 Regional Councils run the regions; Municipal, Town and Village Councils are not sub-ordinate to them[6]. **Figure 2-1** presents the government system in Namibia.

[5] Local Government System in Namibia, 2009.
[6] Local Government System in Namibia, 2009.

Figure 2-1 Government System in Namibia

<table>
<tr><td colspan="4">CENTRAL GOVERMENT
President, prime minister, other ministers
Parliament:
National Assembly
National Council</td></tr>
<tr><td colspan="4">REGIONAL GOVERMENT
14 Regions
Regional council
Governor</td></tr>
<tr><td>PART 1 MUNICIPALITY
Municipal council</td><td>PART 2 MUNICIPALITY
Municipal council</td><td>TOWN
Town council</td><td>VILLAGE
Village council</td></tr>
</table>

Source: Adapted from Peltola 2008, in Local Government System in Namibia, 2009.

To make provision for the direct involvement of the community, Statutory Development Committees were established. These committees are responsible for identifying problems and needs of their specific constituencies; their specific functions include the coordination of planning and development within the constituencies. Statutory Development Committees operate at regional and local levels and are focused on the region, the regional constituencies, the local authority, village and settlement. Although each is composed differently, they are constituted to involve elected members, traditional authorities and representatives from non-governmental and community-based organisations[7].

2.1.3 Population Demographics

(a) Size and Distribution

Table 2-1 Population size and distribution, 2011

Indicator	Namibia		Khomas		Hardap		//Karas	
	2011	2001	2011	2001	2011	2001	2011	2001
Total population	2,113,077	1,830,330	342,141	250,262	79,507	68,249	77,421	69,329
Annual growth rate	1.4	2.6	3.1	1.9	1.5	0.3	1.1	1.1
Population density (persons/km^2)	2.6	2.1	9.2	6.8	0.7	0.6	0.5	0.4
% Urban	43	33	95	93	60	28	54	54
%Rural	57	67	5	7	40	72	46	46
# of Households	464,839	346,455	89,438	58,580	19,307	15,039	21,283	16,839
Household size	4.4	5.1	3.7	4.2	4.0	4.4	4.2	4.7

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

[7] Local Government System in Namibia, 2009.

Table 2-1 provides an overview of the population size and distribution in Namibia, and the affected regions in 2001 and 2011. The national population grew steadily to ~2.1 million in 2011, an average 1.5% per annum increase since 2001. The majority of the population reside in rural areas (57%), and the remaining 43% live in urban centres. There are high rates of rural-urban migration in Namibia; since 2001, the urban population grew by ~50% and the rural population decreased by ~1.5%.

With a population of 342,141, Khomas accounts for 16% of Namibia's total population. Khomas is significantly more populated than Hardap and //Karas which comprise 3.8% and 3.7% of the national population, respectively. The total population in all regions has increased consistently overtime; Khomas had a significantly higher population growth rate than Namibia, Hardap and //Karas between 2001 and 2011. Differing from the national distribution, the majority of the population in all 3 regions reside in urban centres; 95% in Khomas, 60% in Hardap and 54% in //Karas.

The average population density in Namibia is 2.6 people/ km^2, this is low but it is significantly higher than Hardap and //Karas regions which have densities of 0.7% and 0.5%, respectively. Khomas is more densely populated with 9.2 people/ km^2. In the project-affected constituencies, the population density is even lower; ranging from 0.2 people/km^2 in Gibeon to 0.6 people/km^2 in Windhoek Rural.

Between 2001 and 2011, household size has reduced across the project affected area. National level household size is the largest (4.4 people), followed by //Karas (4.2 people), Hardap (4 people) and then Khomas (3.7 people). Households headed by females, children and orphans are considered to be vulnerable; in the project area there are a small percentage of these, as outlined in **Table 2-2**.

Table 2-2 Vulnerable households, 2011

	Namibia	Khomas	Hardap	//Karas
Female headed households	43.8	38.8	36.4	37.1
Child headed households	1.7	1.1	1.2	1.1
Orphan headed households	0.6	0.4	0.6	0.4

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

(b) Sex and Age

Table 2-3 shows the sex and age composition of the population in the potentially affected project area. The distribution of men and women varies across the affected area and over time. There are more females than males in Namibia and in Khomas at 52% and 50.4%, respectively. In Hardap and //Karas there were more males (51% each) than females (49% each) in 2011. The dominance of mining in these regions may account for the elevated number of males.

The Namibian population is relatively young with 37% of people below the age of 15 years. Khomas, Hardap and //Karas have a smaller portion of people below the age of 15 years (27%, 32% and 30%, respectively); at the constituency level, there are slightly more people in this age category, however still fewer than a the national level. The majority of the population in Namibia, Khomas, Hardap and //Karas are of working age (between the ages of 15 and 59 years); Khomas and //Karas have a particularly high percentage of people of working age at 69% and 63%, respectively. The high percentage of working age people in the region may indicate that people migrate to the area for work opportunities or that younger and older people migrate out of the area (particularly //Karas) for schooling and care facilities. However, in the project affected constituencies, the percentage of working age people are far lower (62% in Windhoek Rural to 53% in Berseba.

Table 2-3 Sex and age composition, 2011

Indicator	Namibia		Khomas		Hardap		//Karas	
	2011	2001	2011	2001	2011	2001	2011	2011
Total Population	2,113,077	1,830,330	342,141	250,262	79,507	68,249	77,421	69,329
% Male	48	49	49.6	50.6	51	50.6	51	58
% Female	52	51	50.4	49.4	49	49.4	49	42
Sex ratio: Males/ 100 females	94	94	98	103	104	103	104	114
Age composition (%)								
Under 5 years	14	13	11	11	11	13	11	11
5-14 years	23	26	16	18	21	23	19	20
15-59 years	57	52	69	67	59	55	63	63
60+ years	7	7	4	4	7	8	6	6

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

(c) Language

The main languages spoken in households differed significantly nationally and across the 3 regions (see **Table 2-4**). In Namibia and Khomas, Oshiwambo languages were by far the most commonly spoken first language (~49% and ~41%, respectively). In Hardap, Nama/Damara and Afrikaans were almost equally as dominant at ~43% and 41%, respectively. While in //Karas there were 3 fairly dominant first languages, namely Afrikaans (~36%), Oshiwambo languages (27%), and Nama/Damara (24%).

Table 2-4 Distribution of first languages spoken at household level, 2011

Namibia	Khomas	Hardap	//Karas
Oshiwambo languages (~49%)	Oshiwambo languages (~41%)	Nama/Damara (~43%)	Afrikaans (~36%)
Nama/Damara (11%)	Afrikaans (~18%)	Afrikaans (41%)	Oshiwambo languages (27%)
Afrikaans (10%)	Nama/Damara (~12%)	Oshiwambo languages (~10%)	Nama/Damara (24%)
Otjiherero languages (9%)	Herero languages (~10%)		
Kavango languages (9%)	English (~9%)		

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

2.1.4 Literacy and Education

Table 2-5 presents selected statistics reflecting levels of literacy and education in the affected project area. In 2011, literacy rates in people aged 15 years and older were 97% in Khomas and //Karas, and 91% in Hardap. Hardap and //Karas saw a significant increase in literacy from 2001. These rates are higher than the national rate of 89%. Literacy levels at the constituency level are lower than the regional levels (specifically in Hardap), they are closely aligned with the national literacy level. At a national and regional level, adult literacy was higher in urban areas than in rural areas and there was little difference between males and females. Youth literacy (15-24 years) was highest in //Karas (99%), followed by Khomas (98%), then Hardap (96%); the national average was 94%, similar to the constituencies.

Approximately 13% of children aged 0-4 years attended early childhood development programmes (ECD) (ie. pre-primary school/ kindergarten) in Namibia. This number was significantly higher in urban areas (~19%) than in rural areas (~10%). Slightly more girls than boys were enrolled in ECD programmes in both rural and urban areas. In Khomas, nearly 23% of children attend pre-primary school; with a significantly higher rate of attendance in the urban areas. Approximately 18% of children in //Karas attend pre-primary, with a slightly higher percentage in the urban areas. A low percentage of children are enrolled into ECD programmes in Hardap region (~7%).

At the national level, a high percentage of the population have no or incomplete Primary school education (25%). At the regional level, Hardap has the highest proportion of people with incomplete Primary education (~34%), followed by //Karas (~19%) and Khomas (~17%). The majority of the population have completed Primary school education as their highest qualification (~49% in Namibia, 39% in Khomas, 43% in Hardap, and ~54% in //Karas). The population of Khomas have attained the highest levels of education; ~31% have completed secondary schooling and 13% completed tertiary level education.

Table 2-5 Levels of literacy and education, 2011

Indicator	Namibia		Khomas		Hardap		//Karas	
	2011	2001	2011	2001	2011	2001	2011	2011
Literacy rate, 15+ years (%)	89	81	97	96	91	83	97	87
ECD attendance, 0-4 years (%)	13.3	-	22.9	-	7.3	-	16.9	-
Urban	19.4	-	23.7	-	8.1	-	18.2	-
Rural	9.8	-	8.7	-	6.2	-	15.2	-
Highest education level, 15+ years (%)								
No formal education	1.5	-	0.8	-	1	-	0.7	-
Incomplete Primary	23.7	-	16	-	33.4	-	18.7	-
Complete Primary	48.5	-	39	-	43	-	53.9	-

Indicator	Namibia		Khomas		Hardap		//Karas	
Complete Secondary	20.5	-	31.2	-	19.9	-	22.9	-
Complete Tertiary	5.8	-	13	-	2.7	-	3.8	-

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

2.1.5 Economy, Employment and Income

(a) Economic Overview

The Gross Domestic Product (GDP) of Namibia has grown in excess of 5% per annum since 2010, with the latest GDP growth accelerating to 5.3% for 2014. Strong construction and mining sector activities have been the primary drivers of the consistent domestic economic recovery. However, this has substantially slowed for 2014, due to a general slowdown in demand for commodities in global markets. It is expected that over the next few years, the economy will continue to grow as a result of external demand for goods and services produced in the economy[8]. Namibia's GDP growth exceeded global GDP growth (2.5%) over the medium-term, thus confirming Namibia's relatively healthy economic status.

Namibia's tight monetary policy aimed to keep inflation at 3-6% per annum; this was successfully achieved with the latest inflation rate being 3.3% as at end July 2015[9]. There is thus no concern over an overheated economy, which allows for more stability on the repo rate of the country.

Growth in the primary sector (which represents 20% of the GDP) remained unchanged in 2014. The key reasons for this near zero growth were: a decline in agricultural growth, a fall in the global price of uranium, and weak offshore mining slowed mining growth. Mining dominates the primary sector (63%) with diamonds contributing the largest share. Due to the arid climate, livestock production forms the largest share of the agricultural sector. In order to address Namibia's socio-economic disparities across the regions/ constituencies, deeper structural reforms are required to broaden non-mineral diversification and intensify added value in agriculture[10].

Khomas houses the capital city of Windhoek; making it the administrative, legislative and judicial centre of Namibia. It is also the commercial/ business, educational and transport (ie. rail, road, air) centre of the country; most farming goods produced in the surrounding areas are marketed through Windhoek. Khomas borders Hardap along its southern boundary. This area forms the northern part of the former Rehoboth Gebiet[11], comprising an area which is predominantly cattle-producing (characteristic

[8] African Economic Outlook: Namibia, 2015.
[9] African Economic Outlook: Namibia, 2015.
[10] African Economic Outlook: Namibia, 2015.
[11] The Rehoboth Basters, amongst other 'Baster' groups, migrated north of the Orange River, as they were not permitted to own land in the Cape. They searched for new homes and secure pastures. With Independence, their *Gebiet* ceased to exist; what remained were farms in the personal possession of individual Basters, making it difficult to maintain the cultural cohesion of the group.

of central Namibia). Hardap, however, is predominantly characterised by small livestock farming as is the rest of southern Namibia.

The //Karas region is rich in natural resources, such as alluvial gold, diamonds, iron and zinc, and hosts the country's largest mining activities (predominantly in the region's western constituencies). The perennial Orange River is also a valuable resource to the region, offering high potential for green scheme (irrigation) projects and tourism (eg. river rafting). These projects could have a poverty reducing impact, especially in Berseba, Keetmanshoop Rural and Karasburg constituencies[12].

(b) Agriculture

At the national level, crop farming was the most common type of agriculture as it is practiced by nearly 33% of households, followed by livestock farming (25%) and poultry farming (13.5%). In rural areas, more than half (57%) of households are involved in crop farming followed by livestock farming (42%). Namibia is the most arid country in sub-Saharan Africa; as such land is fragile and productivity is low. In addition, there is substantial land degradation due to large numbers of livestock exceeding the carrying capacity of the rangeland, as well as inappropriate agricultural practices[13].

Due to the arid climate, pastoral livestock farming was the most common agricultural practice in all regions of the project area (~8% in Khomas, ~19% in Hardap, and 12% in //Karas). Crop and poultry farming were considerably less significant, specifically in Hardap and //Karas. The project-affected constituencies throughout the 3 regions are largely rural in nature and heavily reliant on small livestock farming. Overall, livestock farming was even more significant at the constituency-level throughout the Project area (Berseba (~45%), Gibeon (~37%), Rehoboth Rural (~26%), Keetmanshoop Rural (~24%), Mariental Rural (~21%), and Windhoek Rural (~17%))[14].

In the west, south and central areas of Namibia, the majority of households live in small villages and their livestock forage in the surrounding commonage pastures (communal land). On average, households have no more than 10 cattle, goats or sheep[15].

All the potentially Project-affected farms interviewed indicated that they are involved in agriculture. The majority of the farms are used for commercial livestock farming (cattle, sheep and goats), the animals are sold on auction or to the local abattoirs. Many of the farms also farm game; the game is sold for meat, for relocation to other farms or for hunting.

[12] Namibia Poverty Mapping, 2015.
[13] Property Rights and Resource Governance Profile: Namibia, 2010.
[14] Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).
[15] An Overview of Communal Land Tenure in Namibia, 2012.

(c) Tourism

In 2014, there were nearly 1.5 million foreign visitors to Namibia. The majority (~89%) of the visitors were tourists; tourism grew by 34% between 2010 and 2014 and by 12% between 2013 and 2014[16]. During this time, Africans accounted for the largest proportion of tourists to Namibia (notably Angolans, South Africans and Zambians at 40%, 26% and 11%, respectively), European tourists totalled 17% (predominantly Germans at 7%), and 2% were North Americans. The reason for tourist travel to Namibia differed by the origin of the tourists; most Africans (~56%) entered the country to visit family and friends, while 75% of European and 73% of American tourists were holidaymakers[17].

The total economic contribution of travel and tourism equated to nearly 15% of Namibia's GDP in 2014, and is forecast to rise by 5.6% in 2015, and to rise by 7.2% per annum until 2025 (21.6% of GDP)[18]. The total economic contribution includes all direct, indirect and induced expenditure across the economy. Domestic tourists accounted for more than 56% of all direct expenditure in this sector[19].

The project affected regions are sparsely populated and generally valued for their vast open spaces. Tourist attractions are focussed along the coast, with a number of specific attractions located throughout the regions; namely the Hardap Dam, Fish River Canyon and the hot water springs at Ai-Ais. The Project area is primarily used for stock farming; increasingly some of the farmers are offering hunting and eco-tourism (hiking, horse riding, mountain biking) experiences (see Section 2.1.9).

(d) Economically Active and Inactive Population

Khomas is the main employment centre in Namibia; providing jobs to 21% of the employed population. As a result, Khomas (specifically Windhoek) sees high levels of in-migration of rural dwellers in search of employment opportunities. //Karas region provides about 5% of Namibia's employment. Hardap region provides the least employment of these regions.

Table 2-6 provides a summary of the labour force participation rates in the project area. Of the country's economically active population (employed and unemployed), 64% of the national population aged 15 years and above were economically active and ~29% were economically inactive[20]. The economically active population at the regional level was significantly higher at 70% in Khomas, 71% in Hardap and 75% in //Karas. Consequently, the percentage of economically inactive people is lower. In all regions, more males are economically active than females; this is most notable in Hardap and //Karas. There are slightly higher levels of economically active people in urban areas across the project area, with the exception of //Karas where it was equal.

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[16] Tourist Statistical Report, 2014.
[17] Tourist Statistical Report, 2014.
[18] Travel and Tourism Economic Impact Namibia, 2015.
[19] Travel and Tourism Economic Impact Namibia, 2015.
[20] Economically inactive people (ie. students, homemakers and income recipients) accounted for 28.5% of the population and information on 7.5% of the population was not available.

Across the project area, the levels of employment decreased between 2001 and 2011 and the levels of unemployment have increased; with the exception of Khomas where employment levels remained the same. The highest unemployment rate is experienced at the national level (37%), followed by Hardap (35%), then //Karas (32%), and Khomas (30%).

Table 2-6 Economic activity, 2011

Indicator	Namibia		Khomas		Hardap		//Karas	
	2011	2001	2011	2011	2011	2001	2011	2011
Economically active, 15+ years (%)	64	54	74	76	71	64	75	67
Employed	63	69	70	70	65	66	68	71
Unemployed	37	31	30	30	35	34	32	29
Economically inactive, 15+ years (%)	29	39	21	21	23	29	19	24
Student	52	35	69	55	31	29	39	28
Homemaker	15	43	8	24	20	37	15	40
Retired, too old, etc.	27	22	15	21	39	33	35	32

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

According to the Labour Force Survey (2014), the dependency ratio in Namibia is high, at nearly 70%. As such, approximately 7 people must be sustained by every 10 people of economically active age.

The primary employer at the national and regional level is the agricultural sector, with the exception of Khomas where agriculture only accounts for 3% of employment. Retail and construction are also relatively large employers. Administrative work is the most dominant activity in the Khomas region and the second most dominant nationally. Mining is the second largest employer in //Karas region but it is not significant elsewhere. There are some tourist facilities located throughout the area, however these are not significant contributors as regional employers. The main employers are listed overleaf.

Main employers in Namibia[21]: • agriculture, forestry and fishing (30%) • administration and support (9%) • wholesale and retail trade (7%) • construction (7%)	Main employers in Khomas Region[22]: • administration and support (13%) • construction (11%) • wholesale and retail trade (10%) • transportation and storage (7%)
Main employers in Hardap Region[23]: • agriculture, forestry and fishing (29%)	Main employers in //Karas Region[24]: • agriculture, forestry and fishing (32%)

[21] Population and Housing Census Main Report (2013).
[22] Population and Housing Census: Khomas Regional Profile (2014).
[23] Population and Housing Census: Hardap Regional Profile (2014).
[24] Population and Housing Census: //Karas Regional Profile (2014)

• construction (12%) • activities of private households (10%) • wholesale and retail trade (8%)	• mining and quarrying (9%) • wholesale and retail trade (6%) • construction (6%)

The main occupations of the employed population at the national and regional levels are listed below.

Main occupations in Namibia[25]: • skilled agricultural/ fishery workers (26%) • elementary occupations (16%) • service workers (14%) • craft and related trade workers (12%)	Main occupations in Khomas Region[26]: • service workers (17%) • elementary occupations (16%) • craft and related trade workers (16%) • professionals (12%) • technician/associate professionals (10%)
Main occupations in Hardap Region[27]: • elementary occupations (24%) • skilled agricultural/fishery workers (21%) • craft and related trade workers (17%) • service workers (13%)	Main occupations in //Karas Region[28]: • elementary occupations (26%) • skilled agricultural/fishery workers (20%) • service workers (13%) • craft and related trades workers (12%)

(e) Income

Table 2-7 shows the primary income sources across the project area. At the national level, wages and salaries accounted for nearly half (48%) of all household income. The second main source of income was farming (16%), followed by pensions (14%), and non-farming business activities (12%). In urban areas, 68% of households reported wages and salaries as the main source of income, followed by non-farming business activities (15%). The rural areas were very different, reporting farming to be the primary income source (~30%), followed by wages and salaries (28%) and pensions (22.5%).

At the regional level, wages and salaries also dominated as the primary source of income, followed by business in Khomas and pensions in Hardap and //Karas. Despite the prominence of agriculture as the primary employer and occupations, farming accounted for only 7% and 5% in Hardap and //Karas, respectively and just 1% in Khomas. Agriculture is a subsistence/ lifestyle activity for the majority of the population, only those with the means to irrigate, apply fertilisers and employ labour can produce adequate surpluses to be sold[29]. A similar pattern of income distribution is evident at the constituency-level.

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[25] Population and Housing Census Main Report (2013)
[26] Population and Housing Census: Khomas Regional Profile (2014).
[27] Population and Housing Census: Hardap Regional Profile (2014).
[28] Population and Housing Census: //Karas Regional Profile (2014)
[29] An Overview of Communal Land Tenure in Namibia, 2012.

Table 2-7 Primary income sources, 2011 (%)

Indicator	Namibia		Khomas		Hardap		//Karas	
	2011	2001	2011	2011	2011	2001	2011	2011
Farming	16	28	1	1	7	9	5	7
Wages/ Salaries	48	41	73	74	64	61	72	69
Cash remittance	5	6	5	7	7	7	5	6
Business (non-farming)	12	9	14	11	4	5	5	5
Pension	15	11	4	3	15	15	11	10

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

Wealth in Namibia is unevenly distributed, with a national Gini coefficient of 0.42. Wealth inequalities are higher in rural areas (0.45) than in urban areas (0.24). Relative to other regions, //Karas has one of the lowest wealth disparities at (0.28)[30]. However, the incidence of poverty in //Karas is estimated at 14%, having decreased by 3.4% over the past ten years. About 7% of the regional population is estimated to be severely poor, having declined by 2.6% since 2001[31].

The incidence of poverty is estimated to be 17% in Hardap (highest in Gibeon, Rehoboth Rural and Mariental Rural constituencies), 14% in //Karas (with Berseba registering the highest incidence of poverty) and nearly 5% in Khomas region.

At the national level, the average monthly wage is N$6,626. The highest average wage is N$21,749 per month (Mining and Quarrying), while the lowest is N$1,168 per month (private household work). The average monthly wages recorded in the sectors dominant in the project area are listed below[32]; for the majority of sectors males earn more than females with the exception of agriculture and construction.

Sector		Average Monthly Wage
• mining and quarrying	-	N$21,749
• service workers	-	N$4,665
• administration and support	-	N$4,611
• wholesale and retail trade	-	N$4,474
• construction	-	N$4,140
• agriculture, forestry and fishing	-	N$2,114
• elementary occupations	-	None recorded

2.1.6 Health and Welfare

Nationally, there are 14 Regional Health Directorates that oversee service delivery in 34 health districts. The role of each district is to implement regionally directed programmes and projects. Throughout Namibia, there are 30 public district hospitals, 44 health centres, and 269 clinics. Given the vastness of the country, the sparse

[30] The Namibia Demographic and Health Survey, 2014.
[31] Namibia Poverty Mapping, 2015.

distribution of the population, and the lack of access to permanent health facilities in some communities, outreach (mobile clinic) services are provided at about 1,150 outreach points across the country. The national referral hospital (Windhoek Central Hospital) provides support to the district hospitals[33].

In Namibia, the average number of children born per woman dropped by almost 50% to 3.6 children compared to 4.1 children in 2001 and 6.1 children in 1991. There has been no change in fertility over the last 6 years[34]. In 2011, this rate was lower in urban areas (3%) and higher in rural areas (4.3%). The regional and constituency level rates are lower than the national rate at ~3% each (see **Table 2-8**).

Nationally, the maternal median age of first births is 21.6 years; however there was an increase in the percentage of young mothers (aged 15-19 years) from 15% in 2006/7 to 19%[35]. Teenage pregnancy is more than three times higher among young women in the lowest wealth quintile than among those in the highest wealth quintile. Only half of women make use of contraception; use is highest amongst those aged 25-29 years and those living in urban areas. Contraceptive use is positively associated with women's level of education and wealth[36]

The crude death rate (number of deaths / 1,000 people) was the same for Namibia and //Karas (10.7), lower in Khomas (6.7) and higher in Hardap (13). There were a higher number of deaths in rural areas than in the urban centres, across Namibia, Khomas and //Karas; in Hardap, deaths in urban areas exceeded those in rural areas (see **Table 2-8**).

Table 2-8 Health indicators, 2011

Indicator	Namibia		Khomas		Hardap		//Karas	
	2011	**2001**	**2011**	**2011**	**2011**	**2001**	**2011**	**2011**
Average number children/ women (%)	3.6	4.1	2.8	4.9	3.5	3.6	3.1	3.1
Number of deaths/ 1,000 people	10.7	-	6.9	-	13	-	10.7	-
Urban	8.6	-	6.7	-	13	-	10.2	-
Rural	12.2	-	11.5	-	12	-	11.2	-
Disability (%)	5	5	3	4	4	6	4	3

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

Across the country, the HIV prevalence rate has been on the decline since 2002[37]. Between 2006 and 2014, the HIV prevalence rate amongst pregnant women receiving antenatal care has gradually declined nationally from ~20% to 17%[38].

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32 Labour Force Survey, 2014.
33 The Namibia Demographic and Health Survey, 2014.
34 The Namibia Demographic and Health Survey, 2014.
35 The Namibia Demographic and Health Survey, 2014.
36 The Namibia Demographic and Health Survey, 2014.
37 National HIV Sentinel Survey, 2008.
38 Surveillance Report of the 2014 National HIV Sentinel Survey, 2014.

2.1.7 Infrastructure and Services

Table 2-9 presents an overview of selected public infrastructure in the project area. This is discussed further below.

Table 2-9 Public infrastructure, 2011 (%)

Indicator	Namibia		Khomas		Hardap		//Karas	
	2011	2001	2011	2011	2011	2001	2011	2011
Safe water	80	87	99	98	93	95	92	94
Flush toilet (various)	40	-	76.2	-	54.5	-	64	-
No toilet facilities	49	69	20	20	35	34	23	26
Electricity for lighting	42	32	68	69	66	51	67	50
Wood/charcoal for cooking	54	62	8	9	45	20	28	35

Source: Population and Housing Census Main Report (2013), Population and Housing Census: Khomas Regional Profile (2014), Population and Housing Census: Hardap Regional Profile (2014), and Population and Housing Census: //Karas Regional Profile (2014).

(a) Water and Sanitation

In 2013, 87% of Namibian households had access to safe water sources (ie. 37% from piped water into the dwelling, 14% from water piped to the yard, and 26% from a public tap)[39]. Almost all urban households (98%) have access to safe water as compared to 76% of rural households[40]. Over half of households can access water immediately on their premises, while 31% take less than 30 minutes to obtain drinking water, and 15% take more than 30 minutes.

At the regional level, a far higher percentage of households have access to safe water (99% in Khomas, 93% in Hardap, and 92% in //Karas). At the regional level, households in urban areas largely had access to safe water; these levels were lower in rural areas. The constituencies of Rehoboth Rural and Berseba have notably lower levels of access to safe water at 84% and 85%, respectively.

A range of flush toilets are used across the project area. Flush toilets are dominant at the regional level. At the national level, 49% of households have no toilet facilities. Households with no toilet facilities are considerably higher in the rural areas. The majority of the project area is located in rural constituencies with no access to toilet facilities for over 45% of households in the project-affected constituencies in Hardap and //Karas.

Poor sanitation and inadequate access to safe water are public health concerns as they can create conditions conducive to the spread of diseases.

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[39] Namibia Demographic and Health Survey (2014).
[40] Namibia Demographic and Health Survey, 2014.

(b) Energy Sources

The most dominant energy sources differ for lighting, cooking and heating. In Namibia, the most common source of energy for lighting is electricity from the main grid (~42%); with over two-thirds (70%) of urban households relying on electricity, and half of rural households using candles for lighting. On the contrary, 54% of households use wood for cooking (with over 86% relying on wood in the rural areas) and 33% use electricity.

At the regional level, the most common source of energy for lighting was electricity (between 66% and 68%). The majority of households in urban and rural areas relied on electricity (most dominant in urban areas), followed by candles.

Electricity is the main energy source used for cooking in Khomas, Hardap and //Karas (64%, 49% and 42%). In Khomas, the second most common fuel sources were paraffin and gas (14% each) and in //Karas, it was gas (29%). In Hardap, wood was almost as commonly used for cooking as electricity at 45%. The majority of urban households use electricity while wood is the most common fuel for cooking in rural areas.

(c) Housing

The most common house type varies across the project area. Nationally, traditional dwellings are the most common (~38%), regionally, detached houses are the most common; most notably in Hardap. The next most common house types nationally were detached houses (~30%) and shacks (16%); shacks were the second most common regionally. Traditional houses comprised 11% in //Karas and less than 0.6% in Khomas and Hardap.

2.1.8 Land Tenure and Management

When Namibia gained independence in 1990, approximately 5,000 commercial farms (averaging 7,200 ha in size) were owned by white farmers. These were primarily commercial livestock farms. Communal land was largely used for subsistence/ livestock farming and hunter-gatherer activities by approximately 1.5 million people (predominantly Black)[41]. The Ministry of Lands and Resettlement[42] was established and was mandated to "*manage, administer and ensure equitable access to Namibia's land resource"*, as such, their mission was to *ensure that Namibia's land resources were equitably allocated, efficiently managed and sustainably used for the benefit of all Namibians[43].*

Private individuals, entities and the state are all able to own land[44]. There are 5 tenure types specified in Namibia; namely ownership/freehold (private), communal,

[41] Property Rights and Resource Governance Profile: Namibia, 2010.
[42] Now the Ministry of Land Reform.
[43] Ministry of Lands and Resettlement: Strategic Plan 2013-2017, 2013.
[44] Legal Assistance Centre (2005) in Property Rights and Resource Governance Profile: Namibia, 2010.

conservancies, leasehold, and occupancy in informal settlements[45]. Of relevance to this Project are private farms (ownership/ freehold tenure), and state-owned land (communal and leasehold tenure); these are described further below.

- **Private ownership/ freehold tenure**: Owners of freehold land in Namibia have rights to hold the land in perpetuity, to use, transfer, and dispose of the land, and to exclude others from the land. Forty-four percent of Namibia's land comprises freehold tenure.

- **Communal tenure**: About 38% of Namibia is designated communal land. All communal land is held in trust by the state, as stipulated in Article 17 (1) of the Communal Land Reform Act of 2002: *"Subject to the provisions of this Act, all communal land areas vest in the State in trust for the benefit of the traditional communities residing in those areas and for the purpose of promoting the economic and social development of the people of Namibia, in particular the landless and those with insufficient access to land who are not in formal employment or engaged in non-agriculture business activities."*

  Communal land cannot be sold; transfers of use rights are permissible and must be administered by Traditional Authorities and Land Boards. Traditional Authorities and Land Boards are responsible for allocating land for residences, agriculture, or other uses recognised by the Minister. All communal land is registered with the Land Board.

- **Leasehold tenure**: Common law and the Communal Land Reform Act allow for land leases. Leases of communal and commercial land can be granted by Communal Land Boards and government officials for a period of 99 years and may be transferred, inherited, renewed, and mortgaged. Namibians, who were historically unable to access land, can apply for the use of commercial agricultural land. The relevant authority will assign land to these farmers on a contract basis, they are referred to as 'resettlement farmers'; it is expected that the land must be farmed commercially[46].

2.1.9 Project Area

(a) Farm Status

The proposed transmission line passes through 89 farms[47], the distribution and ownership status[48] of these farms is presented in **Table 2-10**. **Figure 2-2** illustrates the freehold and communal areas in the 3 project-affected regions. **Appendix 2** lists the details as provided by the Surveyor General, and the affected farms have been mapped and highlighted for reference.

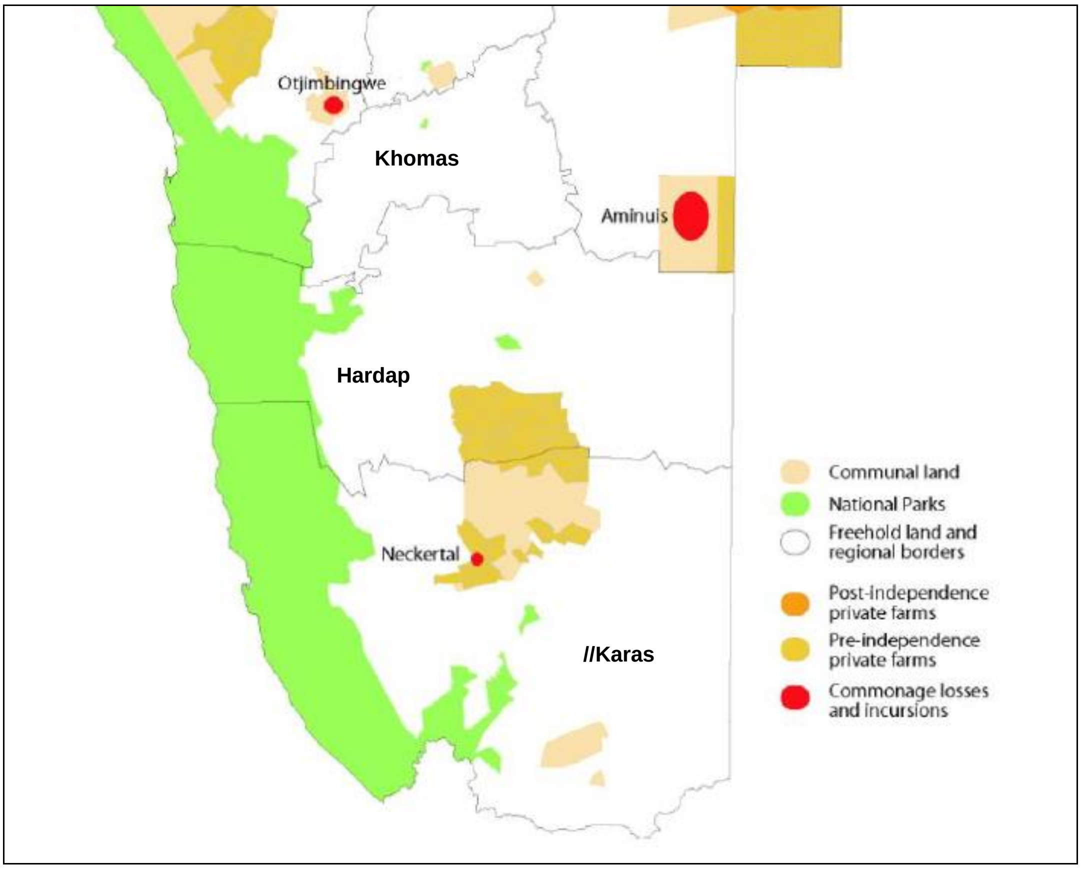
[45] Property Rights and Resource Governance Profile: Namibia, 2010.
[46] Pers comms, various respondents, October 2016.
[47] This information was collected from the Deeds Office. The accuracy of the information is variable.
[48] The ownership status is as captured at the Deeds Office in 2009.

Table 2-10 Distribution and tenure status of affected farms

Region	Constituency	Total Farms	Private		State-Owned	Unknown
			Individuals	Companies		
Khomas	Windhoek Rural	28	22	6	-	-
Hardap	Mariental Rural	19	10	5	3	1
	Mariental Urban	1	1	-	-	-
	Rehoboth Rural	18	13	2	3	-
	Gibeon	10	-	-	10	-
//Karas	Berseba	6	-	1	5	-
	Keetmanshoop Rural	7	2	-	5	-
TOTAL		**89**	**50**	**14**	**24**	**1**

Source: Surveyor General, May 2016 and personal interviews, October 2016.

Figure 2-2 Land tenure map showing freehold and communal areas



Source: Adapted from An Overview of Communal Land Tenure in Namibia, 2012.

The farms located in Windhoek Rural are 100% privately owned by individuals or companies. In Mariental Rural, Mariental Urban and Rehoboth Constituencies, ~82% of the farms are privately owned and 16% are state-owned.

The Rehoboth 'Baster Gebiet' is largely located in Rehoboth Constituency and crosses the boundary into the southern parts of Windhoek Rural Constituency. 'Baster Gebiet' refers to land located in the vicinity of Rehoboth, Duineveld and Kalkrand towns. The Rehoboth Basters, amongst other 'Baster' groups, migrated north of the Orange River, as they were not permitted to own land in the Cape. They searched for new homes and secure pastures. With Namibian independence, their communal 'Gebiet' ceased to exist; the land was divided up into privately owned freehold farms (registered to individual Basters); together with other factors, this made it difficult for the Baster community to retain historical cultural cohesion[49]. These farms are often divided between family members following the death of the registered owners; this occurs informally and is not reflected at the Deeds Office. As such, in practice, these farms may be smaller than those recorded at the Deeds Office.

South of Kries, almost 100% of the farms are state-owned in Gibeon and Berseba constituencies. Five of the 7 affected farms in Keetmanshoop Rural (71%) are state-owned and the remaining 2 are private. In Gibeon and Berseba, some of the state-owned land is leased on a contract basis as 'resettlement farms'; however, the majority of state land is communal and under the jurisdiction of the Traditional Authorities. The Ministry of Land Reform has over-arching responsibility for all state-owned land.

Straddling the boundary of the Hardap and //Karas regions is the communal land (this includes the 'pre-independence private farms); see **Figure 2-2** and **Appendix 2**. The proposed transmission line will run through this area, ending approximately 23km north-east of Keetmanshoop. The communal area is referred to as Namaland and is occupied and used by the Nama people. Kries, Gibeon, Amper-Bo, and Tses are some of the established settlements that accommodate many of the Nama households, education and healthcare facilities. There are structures (including kraals, water points, small houses) scattered throughout the communal area, however these are sparsely distributed.

Based on the information available from the Deeds Office, the farms vary from large commercial farms to subsistence based farms. The farms range in size as follows:

- Windhoek Rural – 55,7143ha to 12486,3955ha (average 4234ha[50]);
- Mariental Rural – 2132,5081ha to 21125,4031ha (average 6634ha[51]);
- Mariental Urban – 400,3935ha[52];
- Rehoboth Rural– 0,1050ha to 2950,5441ha (average 1482ha[53]);
- Gibeon – 2184,8179ha to10384,1156ha (average 6268ha[54]);
- Berseba – incomplete information[55]; and
- Keetmanshoop Rural – 2158,2846ha to 12483,0890ha (average 6724ha[56]).

[49] Rehoboth, Namibia – Past & Present, 2012.
[50] Average based on 20 farms.
[51] Average based on 16 farms.
[52] Only 1 affected farm in Mariental Urban.
[53] Average based on 10 farms.
[54] Average based on 10 farms.
[55] Farm area only provided for 1 out of 6 farms.
[56] Average based on 6 affected farms.

(b) Land Use

Most Project affected farms are used for commercial livestock farming. Cattle, sheep and goats are farmed across the Project area; the animals are sold to local abattoirs and on auction. The private commercial farmers often own/ farm more than one farm; this is most notable for the smaller land parcels that are not commercially viable when farmed in isolation. Typically, each land parcel is divided into several camps (each one fenced) to enable rotational grazing and effective farm management.

There are several other farms that practice commercial livestock agriculture and have relatively significant tourism offerings (hunting and eco-tourism including (hiking/ walking, horse riding, mountain biking, and photography); they include but are not limited to Hohenau, Hohewarte, Voigtland, Koichas, Rem. Of Ptn. 5 of Orab, Wilderness Rem Ptn[57].

There are 3 known farms that are used solely for tourism activities; namely Rem of Gravenstein, Ptn 2 of Duineveld and Ptn 3 of Duineveld. Over the past 5 years, all infrastructure and domesticated livestock have been removed and game introduced to restore these farms to their natural and pristine state. The farms offer exclusive hunting and eco-tourism options to guests.

Tourist numbers are reported to have been increasing into the area[58], specifically to the farms in Khomas and Rehoboth Rural constituencies due to their relative proximity to Windhoek. The tourists that visit these farms include Namibians, South Africans, Americans and Europeans.

Most of the commercial farmers reside on the farms together with their workers. Some landowners live and work in town and use their farms as weekend retreats, the workers manage the livestock in the absence of the landowner.

The 'resettlement farms' are required, by contract, to be farmed commercially. The communal land is expansive and largely unfenced, livestock roam freely over the area and due to the general lack of effective land management and lack of water, the area is currently extremely over-grazed and degraded (see **Figure 2-3**). There are no reports of tourism or other economic activities on the 'resettlement farms' or communal land.

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[57] This information is based on key informant interviews; not all land owners/users were contacted/ available for interviews.
[58] Several of the land owners reported that the tourism market is increasing.

Figure 2-3 Private commercial farm (left) versus State land (right)

Source: Photographs by Kerryn McKune Desai, August 2015.

(c) Infrastructure and Services

It seems that almost all the potentially affected farms have some form of infrastructure on them; notably residential dwellings, out-buildings, water sources, large fenced camps, small kraals, gravel roads, fire breaks.

Access to reliable electricity supply, telephone lines and internet varies across the area.

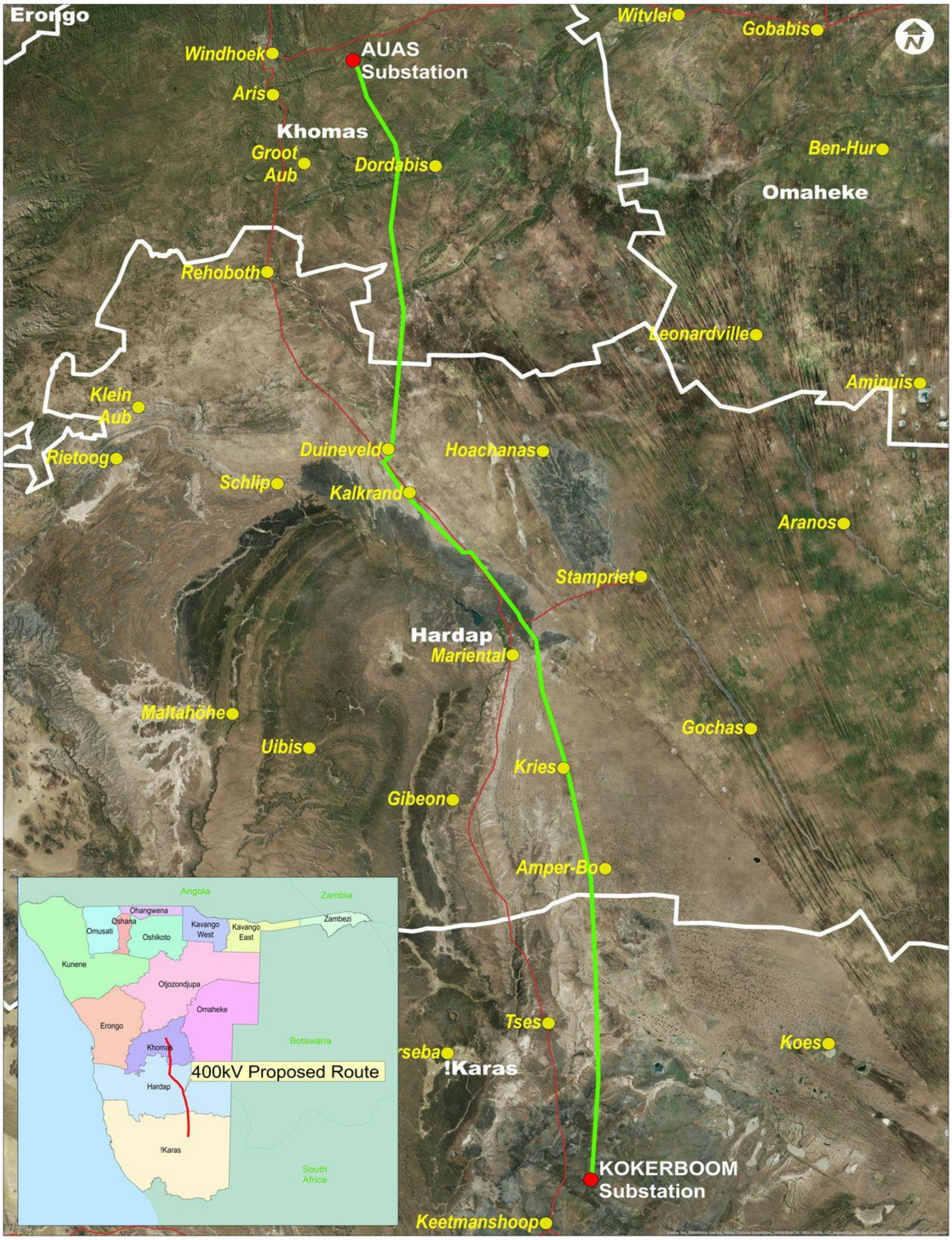
3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1 Overview

NamPower proposes to construct a single-circuit 400kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500km. There are an existing 400kV and a 220kV transmission line connecting the two substations but these follow a different route. The final transmission line servitude will be 80m wide, with 12m of that being cleared for an access track.

The proposed transmission line corridor alignment runs south from the Kokerboom Substation and then parallel to the 220kV transmission power line from Kalkrand southwards. It will exit the existing Kokerboom Substation in a southerly direction and enter the existing Auas Substation from the north (see **Figure 3-1**).

Figure 3-1 Locality Plan indicating the proposed alignment of the Kokerboom – Auas Transmission Line



The proposed transmission power line traverses 3 regions, namely Khomas, Hardap and //Karas. There are 7 potentially affected constituencies, Windhoek Rural, Mariental Rural, Mariental Urban, Rehoboth Rural, Gibeon, Berseba and Keetmanshoop Rural (see **Figure 3-1** and *Appendix 2*).

The infrastructure proposed includes a 400 kV transmission line conductor strung onto 45 m high steel pylons, of the Open-V or the Self-Supporting design, placed approximately 500 m apart. These pylons will be placed on a 10 m by 10 m concrete base. The line needs to be at least 100 m away from the 220 kV power line.

The proposed construction work to be carried out includes:

- site establishment, including site demarcation and fencing (temporary and only where required), layout and establishment of the contractor's camps including ablution and cooking facilities (this will only be established if required by the appointed Contractor);
- digging of holes for the concrete pylon base;
- casting of concrete platforms for the pylons;
- transportation of plant, machinery and equipment to site;
- transport of the conductor into position by means of a pulley system or by rolling large coils of conductor into position;
- hoisting and lifting of the pylons into position;
- stringing of the conductor; and
- construction of the access road.

The transmission power line will take approximately 24 months to construct, depending on whether one or more Contractors are appointed to undertake the work and/ or there are one or more working fronts. Most experienced contractors can string the lines at a rate of approximately 6 km/ day so the work will proceed along the line relatively quickly. Each farmer will be 'disturbed' intermittently for a period of 6 to 8 weeks during the construction period. This period would depend on the length of power line on each farm.

If Environmental Clearance is granted and prior to construction, NamPower will approach each one of the potentially affected farmers with the view of negotiating use of an 80 m wide 'right of way' servitude over the affected properties for the purpose of constructing and operating the proposed transmission line. Negotiations will include access requirements (including gates), which will be locked at all times; keys will be provided to both parties. Infrequent access will be required (approximately every 3 years). A final 'walkdown' of the proposed centreline of the transmission power line corridor alignment will be undertaken and the sites of each of the pylons finalised and demarcated. During final positioning of the pylons, sensitive features (e.g. plant habitats and archaeological sites) will be avoided.

An Environmental Management Plan (EMP) for the construction and operational phase will be compiled. They will be included in the tender documentation and the Contract with the appointed Contractor(s). It will contain all mitigation measures/ management actions proposed in this EIA process and will be included in draft format in the Assessment Report.

NamPower has operated the existing 400kV and 220kV transmission power lines between the Kokerboom and Auas Substations for the past 16 and 17 years, respectively.

The operation of the power line will be a continuation of the *status quo* operational and maintenance activities, namely:

- site inspections, including Technical and Safety, Health, Environment and Wellness (SHEW);
- power line housekeeping;
- vegetation management, including herbicide application and manual vegetation clearing; and
- maintenance of the powerline and repair of the access roads.

Specific details regarding the construction process, number and type of employees, worker accommodation and procurement will only be determined once an EPC contractor is appointed. In the interim, it is expected that most construction phase workers will require specialised technical skills; there will be some unskilled work available to local residents (estimated to be 10% of the total construction phase workforce) and indirect economic opportunities (e.g. sale of food, cleaning, and accommodation). During the operational phase, there will be few additional employment opportunities as the existing team will extend the scope of their tasks to include the maintenance and management of the proposed 400 kV line.

The above construction and operational activities formed the development ‘proposal’ (referred to as the proposed Project) as assessed in the EIA process.

3.2 Alternatives

A number of alternatives (‘no-go’, technology, methods of construction and operation, equipment, and mitigation measures) to the construction and operation of the transmission power line were considered by NamPower and assessed during the EIA process.

The ‘no-go’ alternative is not recommended given the importance of the Kokerboom to Auas transmission line in power supply to Namibia. The demand for power is continually increasing as a result of population expansion, diminishing power supply from Namibia’s neighbouring countries, as well as residential, mining, agricultural and industrial development. The existing 400kV and 220kV power lines cannot cope with the expected power transmission requirements into the future. A new line is currently predicted to be needed to come on line with the overall transmission line system within the next 5 to 10 years. Should the Kudu Gas Project come on line earlier than expected then the transmission power line will be required earlier.

Three alternative power line corridors were assessed during the Scoping Assessment. Each alternative was scoped and a new alternative put forward for assessment that avoided potential negative biophysical and socio-economic impacts. The power line corridor is 250m either side of the proposed centre line.

The technical specialists although involved in the scoping of the power line corridor alternatives only assessed the ‘favoured’ alternative in detail. The preferred corridor alignment avoided sensitive environmental features, most notably sensitive perennial pans and an avifauna hotspot and social infrastructure such as landing strips, recreational areas, homesteads, tourist lodges, towns, villages etc.

In sourcing the specific equipment for the proposed transmission line project, NamPower will assess alternatives in terms of availability, efficiency, compatibility with the existing equipment, cost and environmental sustainability, before making a final decision.

Operational alternatives are limited as NamPower already has an operational protocol for the 400kV and 220kV power lines between the Kokerboom and Auas Substations, as well as its other transmission lines, which are being implemented satisfactorily. Operational procedures will be a continuation of the *status quo,* as new operational procedures are considered unnecessary by NamPower given that the current ones are tried and tested and considered effective, efficient and sustainable.

4 IMPACT ASSESSMENT AND PROPOSED MITIGATION

4.1 Introduction

The focus of the assessment is on the impacts that the proposed Project will have on the social environment as described in the baseline chapter (Section 2) and on ways in which the impacts can be mitigated. Each impact has been assessed using Lithon's impact assessment methodology for the construction and operation phases of the Project (see *Appendix 3*).

4.1.1 Potential Impacts Identified for the Project

As a result of the proposed Project activities and the nature of the surrounding social environment, the following potential impacts have been identified (see **Box 4-1**); these are described and assessed in Sections 4.2 and 4.3.

Box 4-1 Social Impacts

Construction:

- Generation of employment and procurement opportunities
- Disruption to livelihood activities and lifestyle
- Destruction/ disturbance to homesteads and farm infrastructure

Operation:

- Benefits for the economy
- Changed sense of place *(resulting in disruption to tourism/ hunting activities)*
- Disruption to farm management

4.2 Construction Phase Impacts

4.2.1 Generation of Employment and Procurement Opportunities

During the construction phase of the proposed Project (~24 months), local employment and procurement opportunities will be created.

The Engineering, Procurement, and Construction (EPC) contractor will be appointed through a rigorous tender process; as such, any company could apply. The origin of the company and its workers is therefore not known and the exact number of workers will depend on the approach to construction proposed by the EPC.

The construction work is highly technical, as such, the majority of workers (~80%) will require specific technical capabilities and experience in the field of electrical installations. There will be some scope to use unskilled casual labour for tasks such as site clearance and other basic activities; a relatively small number of people will be employed in this regard and paid minimum wage for short-term, *ad hoc* employment. Where unskilled labour is required, people originating from the local area will be employed; however, the impact is unlikely to make a noticeable difference to the already high regional unemployment rates (35% in Hardap, 32% in //Karas and 30% in Khomas as compared to an unemployment rate of 37% nationally).

The majority of employment opportunities will be secured by already skilled personnel. In terms of NamPower's Economic Equitable Policy (NEEP), tenderers are required to pledge a small percentage (e.g. 2.5%) of the contract value towards capacity building.

NamPower have estimated that they will spend an average of N$ 2 million per kilometre of transmission line constructed (~500km). They could not indicate exactly how this amount would be spent or what percentage of this amount would benefit the local, regional and national economy's; however, they provided an indicative overview of the distribution of anticipated procurement spend (see **Table 4-1**). It is expected that a large proportion will be spent to procure goods and services and pay the wage bill.

Table 4-1 Indicative Procurement Spend

	Hospitality Industry	Fuel	Glossaries	Casual Labour	Contracting services	Construction Materials
Constituency	X	X	X	X		
Regional	X	X				
National		X			X	X
International						X

Source: NamPower (2016).

Once the EPC contractor is appointed, more clarity will be available with regards to the number and type of job opportunities, origin of workers, and the type/ source of goods and services to be procured.

Table 4-2 Construction Phase: Employment and Procurement

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Employment and Procurement										
Impact Description The employment and procurement of goods and services during the construction phase will be a positive impact. Given that skilled personnel and specialist goods and services will be sourced nationally (and potentially internationally), the extent of the impact will be high. This impact will be experienced for the duration of the ~24 month construction phase (short-term), as such the duration will be low. The intensity will be low due to the limited number of construction jobs available for local people. While some basic goods and services will be procured locally, the majority of procurement will benefit the national and international economy. Based on the extent, duration and intensity, the consequence is expected to be low and there is a high probability that the impact will occur. It is expected that economic benefits arising from employment and procurement will be experienced at the national level, albeit relatively low in comparison to the size of the national economy.										

<table>
<tr><td colspan="11">The impact resulting from employment and procurement is assessed to be one of LOW positive significance. Post mitigation, it may be possible to increase the intensity and thus the impact significance to one of LOW-MEDIUM positive significance.

The specialist has assessed the impact based on limited available information; as such, confidence is medium.</td></tr>
<tr><td>Without Enhancement</td><td>Positive</td><td>High</td><td>Low</td><td>Low</td><td>N/A</td><td>N/A</td><td>Low</td><td>High</td><td>LOW +</td><td>Med</td></tr>
<tr><td colspan="11">Enhancement Measures

• NamPower should strive to appoint a Namibian company to undertake the work, assuming that they are able to meet the tender requirements.
• The EPC contractor will maximise the recruitment of local people, where possible. Preference to be given to people originating from the directly affected constituencies. Workers must be hired from all constituencies.
• Identification and appointment of local people should be undertaken in consultation with the regional and constituency-level authorities at least 6-months prior to the commencement of construction.
• No hiring is to take place ‘at the gate’, only specified recruitment channels will be followed.
• The workforce should provide equal opportunities to a diversity of demographic characteristics for recruitment (e.g. sex, age, ethnicity, cultural/ religious affiliation).
• All recruitment should be undertaken in terms of legislated basic conditions of employment, including appropriate health and safety measures.
• The successful Tenderer should specify what percentage of the contract value will be assigned to capacity building (as per NEEP). The Tenderer should compile a capacity building plan that benefits all employees but specifically aims to enhance the skills of workers originating from the directly affected constituencies.
• Goods and services should be procured locally, wherever possible. Where this is not possible, regional suppliers should be used. Only where it can be demonstrated that the goods and services are not available locally or regionally, national suppliers should be used.
• Implement a grievance procedure that is easily accessible, culturally appropriate and scaled to the potential risks and impacts of the Project. Complaints related to contractor or employee behaviour will be lodged and addressed through this procedure. Key steps of the grievance procedure include:
o circulation of contact details of ‘grievance officer’ or other key contact to all I&AP;
o awareness raising among stakeholders regarding the grievance procedure and how it works;
o establishment of an electronic grievance register which will be updated regularly, including all escalation actions, responses and response times;
o grievance resolution to be signed off by the complainant; and
o if the grievance is not addressed or closed out properly, there should be an avenue through which the matter is escalated to a higher level of authority for resolution.</td></tr>
<tr><td>With Enhancement</td><td>Positive</td><td>High</td><td>Low</td><td>Medium</td><td>N/A</td><td>N/A</td><td>Low-Med</td><td>High</td><td>LOW-MEDIUM +</td><td>Med</td></tr>
<tr><td colspan="11">Cumulative Impact

The temporary employment of a limited number of local people will be positive, however it is unlikely to make a material difference to the relatively high unemployment level. Local procurement is not expected to be high given that the specialist goods and services are most likely to be sourced nationally and internationally. The cumulative impact related to employment and procurement will be insignificant at the local level. Regionally/ nationally, the income derived through procurement and employment will be substantial but is likely to be a low positive relative to the national economy.</td></tr>
</table>

4.2.2 Disruption to Livelihood Activities and Lifestyle

The Project area is characterised by an expansive and sparsely populated landscape. The majority of the Project affected farms are used for livestock farming, some are used for livestock agriculture, hunting and eco-tourism activities[59], and 3 are used exclusively for hunting and eco-tourism[60]. Most farmers reside on their farms, some live in town and visit the farms on the weekend. Tourist accommodation is offered on selected farms.

The Project area offers a peaceful and isolated experience that is used as an escape from city life by Namibian nationals, foreign tourists and landowners themselves. Residents and visitors enjoy the environment based on the lack of large-scale physical infrastructure and absence of noise and general disturbances. This sense of place that appeals to the land owners and draws tourists and weekend users to the area will potentially be impacted upon because of various nuisance factors and social ills that may arise as a result of the proposed construction phase activities.

Currently, the extent of daily activities on these farms are low key and do not generate much visual, noise or other disturbances. Farming and tourism activities do not require significant numbers of workers, as such there are few people living on the farms.

The farms in Khomas, Rehoboth and Mariental Rural are largely well-managed and therefore, more vegetated than the farms in Gibeon, Berseba and Keetmanshoop Rural, where the area is generally overgrazed and degraded. The farms in Khomas, Rehoboth and Mariental Rural make use of numerous fenced camps to control grazing thus ensuring that the vegetation continually re-establishes itself. Fencing is regularly checked and maintained to ensure that the animals are contained.

The farms along the southern section of the line typically do not used fenced enclosures, as such animals are free to roam and graze on a continuous basis across the area. As a result, the farms are more barren and lacking in vegetation.

Construction activities will involve site establishment (including contractor camps located approximately every 100km and close to towns and services), digging holes for pylon bases, casting concrete platforms, transportation of materials/ equipment, hoisting/ lifting of poles, stringing the conductor, and access road construction. Gates will be installed into fences to enable the construction and operational teams to move freely along the proposed route. The construction area will only be fenced where required for safety and security precautions. Worker camps are likely to be established every ~100km. Access to land for this purpose will be negotiated with farmers and is likely to be situated close to towns to enable access to goods and services.

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[59] Farms used for livestock agriculture and tourism include but may not be limited to Hohenau, Hohewarte, Voigtland, Koichas, Rem. of Ptn. 5 of Orab, Rem of Lekkerwater and Wilderness Rem Ptn. Findings are based on feedback from the interviews, not all landowners/ users were available or contacted.

[60] Farms known to be used exclusively for hunting and eco-tourism are Rem of Gravenstein, Ptn 2 of Duineveld and Ptn 3 of Duineveld. They are striving to be exclusive tourist destinations.

The construction activities and the presence of workers will result in a number of nuisance factors such as noise, dust, visual, security and safety risks. Construction vehicles and the presence of construction workers will be the primary sources of noise. Dust will be generated from digging and construction vehicles. The open holes, installation of gates and access through the gates will pose a risk to animals who currently move freely over the area (within the fenced camps).

The most commonly raised concerns regarding potential nuisance factors during the construction phase are:

- potential damage to vegetation located within and beyond the defined construction area;
- construction related debris and litter;
- uncontrolled access to the farms;
- damage to fences and farm infrastructure; and
- animals escaping through demolished fences or open gates.

In similar projects, concerns are also regularly raised regarding unauthorised hunting and theft of livestock and game.

Typically, an influx of workers and job-seekers can be anticipated into an area where there are potential job opportunities. As a worst case scenario, influx can be associated with increased levels of crime, increased spread of sexually transmitted diseases (including HIV/AIDS), unwanted pregnancies, domestic violence, alcohol and drug abuse, and increased levels of tension within the community. However, the influx of job-seekers is expected to be limited for a project of this nature and the extent of the Project area.

Table 4-3 Construction Phase: Disruption to Livelihood Activities and Lifestyle

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Disruption to Livelihood Activities and Lifestyle										
Impact Description The construction activities will generate a range of nuisance factors (e.g. noise, dust, visual intrusions) resulting from vehicles, machinery, equipment and workers. This is likely to impact negatively on the general sense of place for residents and tourists; animals may also be affected by sudden loud sounds and increased activity on the farm. When the fences are being fitted with gates and the gates are open enabling access, there will be a risk of livestock and game escaping. The presence of workers onsite may increase the risks of vandalism, theft and general security on the farm to people, possessions, infrastructure and livestock. Construction activities will generate waste materials and debris. Construction phase activities, associated disturbances and potential risks will be experienced in the immediate proximity of the site (low extent). The total construction duration is ~24 months (short-term) but the impact will be experienced at single locations for short periods of time (6-8 weeks) as the work progresses along the line; as such the duration will be low for each farm. The intensity will be low to medium; the construction-related nuisance factors will be relatively minor but they may still cause annoyance, disrupt the peaceful sense of place, and affect livestock/ game.										

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
However, the increased number of workers may increase the intensity of the impact slightly due to more unpredictable actions. Based on the extent, duration and intensity of the impact, the consequence is expected to be low. There is a high probability that the impact will occur. The potential disruption to livelihood activities and lifestyle is assessed to be one of LOW to MEDIUM negative significance. Post mitigation, it may be possible to reduce the impact significance to one of low negative significance. The specialists' degree of confidence is medium.										
Without Mitigation	Negative	Low	Low	Low-Med	N/A	N/A	Low	High	LOW-MEDIUM -	Med

Mitigation Measures

Pre-construction planning and negotiation

- Given the long delay between Environmental Authorisation and construction, NamPower will reconfirm the details of the affected landowners and users during the detailed planning phase.
- NamPower will negotiate fair compensation with the landowners and users; this should account for disruptions to livelihood activities (e.g. agriculture, hunting and tourism). This is a private negotiation that will be handled on an individual basis.
- The construction schedule and process should be designed to avoid the high tourist and hunting seasons. The landowners and users involved in tourism activities should be requested to confirm this information as part of the detailed planning process prior to construction.
- The construction schedule should be discussed with the commercial farmers to enable them to plan the rotation of livestock accordingly. Their limitations should be accommodated, where possible.
- The schedule and approach to construction must be presented to the directly affected receptors and constituency leaders for input prior to finalisation.

Generic construction phase management measures

- Each affected landowner or user must complete a site 'audit' before construction commences. They should document the state of their properties and assets prior to construction; the inclusion of photographs should be encouraged. Post-construction, the site should be reassessed to ensure that the farm is left in an acceptable state.
- Post-construction, the affected landowner or user should be invited to join NamPower and the appointed contractor for a 'walk down' the power line route to identify any outstanding issues.
- Traffic management measures to be implemented as specified in the EMP.
- Dust suppression measures to be implemented as specified in the EMP.
- Visual disturbance measures to be implemented as specified in the EMP.
- Safety measures to be implemented as specified in the EMP.

Recruitment procedures to enhance local employment

- Apply all mitigation measures as described in Section 4.2.1 to enhance local employment. This will serve to reduce the number of general workers from outside the area, and discourage influx.

Workforce management

- The locations of the worker camps and laydown areas should be identified in consultation with the relevant local authorities. Agreement should be given by the landowner and all neighbouring landowners.
- The worker camp should be fenced and access to and from the camp strictly controlled to prevent trespassing into unauthorised areas.
- The worker camps should be established and managed in a manner that ensures that the workers have access to all basic services and occupational health and safety regulations are to be adhered to by the contractor. Workers should not need to exit the camp. Basic needs will include but may not be limited to food, water, sanitation, accommodation, recreation and medical care.
- All construction staff will agree to a Code of Conduct (CoC) that outlines protocols and standards for working on

Impact	Nature	Extent	Duration	Intensity	Reversibility	Impact on Irreplaceable Resources	Consequence	Probability	Significance	Confidence
the affected land. The CoC should address the following: o respect for local residents; o respect for existing livelihood activities and the environment; o no hunting, snaring or unauthorised taking of any property belonging to someone else; o compliance with the Traffic Management Plan and all associated regulations; o disciplinary measures for not adhering to the Code of Conduct. • If workers are found to be in contravention of the CoC, which they are to sign at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. Damage to property, trespassing and theft should be noted as dismissible offences. • Workers from outside the area should be able to return home on a regular basis, as agreed in their contracts. • Develop and implement an HIV/AIDS policy and information document for all staff on the proposed Project. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS. Condoms to be made available to employees and all contractors. **Ongoing engagement and grievance management** • Implement the grievance procedure as described in Section 4.2.1.										
With Mitigation	Negative	Low	Low	Low	N/A	N/A	Low	Med	LOW -	Med
Cumulative Impact The proposed Project will be located on farms that are used only for livestock farming, hunting and eco-tourism. There are currently no significant activities that generate disturbances to the existing land uses. The construction activities will temporarily result in escalated noise, dust, traffic and other nuisance factors, as well as alterations to fencing and site access. Besides the impacts identified there are no known cumulative impacts linked to other planned developments.										

4.2.3 Destruction or Disruption to Homesteads and Farm Infrastructure

There have been several alterations to the route of the proposed transmission line to minimise most identified environmental and social impacts. Through various technical assessments, specialist studies and stakeholder feedback, key sensitivities were identified. NamPower has made every effort to alter the alignment, where technically feasible, to avoid all sensitivities. All known farm infrastructure was identified and avoided, wherever possible; this included homesteads, tourist facilities, air strips, sensitive view sheds and vegetated areas that are valuable to tourism and sense of place.

NamPower’s preference is to maintain a 500m buffer around all built areas and sensitive receptors. Where the terrain and other environmental and technical considerations allow, this distance is applied. However, the minimum legally required buffer for a 400 kV power line from built up areas is 80m. There is infrastructure of varying descriptions located within the 250m buffer on either side of the proposed route alignment (500m corridor); no known structures are located closer than 80m to the proposed line.

As a result of the various route alignments, all known structures have been avoided. The construction process will result in impacts on fencing, as gates will need to be incorporated into fences along the proposed route to enable construction and operation vehicles to travel the full length of the line. The farm owner/ user and NamPower will retain keys to these gates.

Table 4-4 Construction Phase: Impact on Homesteads and Farm Infrastructure

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Impact on Homesteads and Farm Infrastructure										
Impact Description Following a number of alterations to the proposed route alignment, the impact on homesteads and farm infrastructure resulting from construction activities would remain a negative impact that will be experienced in the immediate proximity of the site (low extent). The total construction duration is ~24 months (short-term) but the impact will be experienced at single locations for short periods of time (6-8 weeks) as the work progresses along the line; as such the construction phase duration will be low for each farm. The intensity will be low given that all known farm infrastructure has been avoided. There may still be impacts to some view sheds from residences and there will be planned alterations to fences; however, these alterations may be seen as a positive for some farmers. Based on the extent, duration and intensity of the impact, the consequence is expected to be low. There is a high probability that the impact will occur. The impact on homesteads and farm infrastructure resulting from construction activities is assessed to be one of LOW negative significance. Post mitigation, it may be possible to reduce the impact significance to one of low to very low negative significance. The specialists' degree of confidence is medium.										
Without Mitigation	Negative	Low	Low	Low	N/A	N/A	Low	High	LOW -	Med
Mitigation Measures **Pre-construction planning and negotiation** • Given the long delay between Environmental Authorisation and construction, NamPower will reconfirm the location of all farm infrastructure during the individual negotiations with landowners and land users. • Where technically and financially feasible, NamPower will alter the route to avoid infrastructure; alternatively, they will negotiate suitable compensation with the land owner or land user. This is a private negotiation that will be handled on an individual basis. **Generic construction phase management measures** • Implement all traffic, noise, dust, visual, safety measures as specified in the EMP. • Implement all workforce management measures as specified in Section 4.2.2. **Damage to property** • Any damage to property (intentional or unintentional) by workers or construction equipment will be compensated in a manner agreed to by the landowner or land user. **Ongoing engagement and grievance management** • Implement the grievance procedure as described in Section 4.2.1.										
With Mitigation	Negative	Low	Low	Low	N/A	N/A	Low	Med	LOW-VERY LOW -	Med

Impact	Nature	Extent	Duration	Intensity	Reversibility	Impact on Irreplaceable Resources	Consequence	Probability	Significance	Confidence
Cumulative Impact There are no known cumulative impacts on homesteads and other farm infrastructure.										

4.3 Operational Phase Impacts

4.3.1 Benefits for the Economy

Operation of the proposed 400 kV transmission line will deliver benefits nationally, offering more secure and reliable power supply across Namibia. The benefits can only be derived in areas where there is adequate infrastructure in place to deliver power to the end users. Respondents in local constituencies such as Berseba and Gibeon raised concerns about the lack of electricity and the associated impact on quality of life. Unfortunately, this project will not alleviate the concerns in these areas as the constraint in those constituencies is that local infrastructure is inadequate.

The operation of the proposed transmission line, will not require many additional personnel to those already employed to operate the existing infrastructure. Existing staff will broaden the scope of the 400 kV transmission line. It is possible that a small number of additional skilled personnel will be employed.

In areas where the positive effects of more secure and reliable power supply are experienced, there may be slight improvements to business productivity and quality of life. Some indirect and induced employment, as well as enterprise development opportunities may be possible. However, in relation to the existing economy nationally and in the indirectly affected areas, these opportunities will be insignificant.

Table 4-5 Operational Phase: Benefits for the Economy

Impact	Nature	Extent	Duration	Intensity	Reversibility	Impact on Irreplaceable Resources	Consequence	Probability	Significance	Confidence
Impact: Benefits for the Economy										
Impact Description Benefits may be experienced as a positive impact for the national and regional economies (high extent); some local economies may also benefit. This impact will be experienced for the long-term/ throughout the operational life of the transmission line (and the associated infrastructure which is beyond the scope of this assessment), as such the duration will be high. The intensity will be low in the context of the broader economy; the benefits are most likely going to be experienced as generally more reliable and secure power that may or may not translate into actual economic benefits nationally. A relatively small number of jobs will be created. Based on the extent, duration and intensity, the consequence is expected to be medium and there is a low-medium probability that the impact will occur.										

The benefits for the local economy are assessed to be of LOW-MEDIUM positive significance. No enhancement measures are proposed as little can be done to further enhance this impact. The specialists' degree of confidence is medium.										
Without Enhancement	Positive	High	High	Low	High	N/A	Med	Low-Med	LOW-MEDIUM +	Med
Enhancement Measures • No additional enhancement measures are required to enable this impact to materialise.										
With Enhancement	Positive	High	High	Low	High	N/A	Med	Low-Med	LOW-MEDIUM +	Med
Cumulative Impact The proposed Project will enable existing businesses to operate more consistently and potentially expand. If businesses expand/ grow as a result of the improvements to power supply, the benefits to the economy may intensify. This is difficult to predict with any kind of certainty.										

4.3.2 Changed Sense of Place

As described in Section 4.2.2, the Project area is characterised by an expansive and sparsely populated landscape that offers a peaceful and isolated experience, that is used as an escape from city life by Namibian nationals, foreign tourists and landowners themselves. The lack of large-scale physical infrastructure and absence of noise and general disturbances contributes to a sense of place that provides emotional, psychological, mental and economic value.

This sense of place may change for some people as a result of the visual intrusion caused by the presence of the proposed 400 kV transmission line. Reactions to, and opinions of, the transmission line will vary between people. Some people will view it as extremely invasive and may allow it to degrade the quality of their experience. Others may not even notice it and will forget about it the moment they have seen it. Almost all people will understand the necessity of the line and acknowledge that it is a requirement in most locations.

The majority of the Project affected farms practice livestock farming only. In addition to agriculture, some farms offer tourism and hunting experiences and 3 farms[61] are focussed exclusively on tourism; the latter have made an effort to remove all infrastructure and domesticated animals to enhance the natural experience. The farms offering various tourism activities are likely to be most affected by the presence of the line. Some of the land owners indicated that they treasure the ambiance of the area and that the transmission line will degrade the landscape.

[61] Farms known to be used exclusively for hunting and eco-tourism are Rem of Gravenstein, Ptn 2 of Duineveld and Ptn 3 of Duineveld. They are striving to be exclusive tourist destinations.

Figure 4-1 and **Figure 4-2** show selected views on Rem of Lekkerwater and Hohewarte, both farms are used for both livestock farming and tourism. The landowner of Rem of Lekkerwater is concerned that given the flat landscape, the line will be visible from most points on the farm.

Figure 4-1 Selected views at Rem of Lekkerwater

Source: Photos provided by the land owner (PPP).

Figure 4-2 Selected views and activities at Hohewarte

Source: http://www.hohewarte.com/

There are a number of Project affected farms, as well as others in the area, that continue to operate successful eco-tourism and hunting facilities despite the presence of transmission lines on their land. They indicated that they have never received negative feedback about the existing lines and that despite their presence, the tourism business continues to grow. **Figure 4-3** is an image retrieved off the website of Auas Safari Lodge; the image illustrates a landscape at an exclusive tourism facility. Despite the presence of a 400 kV transmission line, the landscape is considered attractive enough to use as marketing; the line is barely visible.

Figure 4-3 View across farm with similar transmission line

Source: http://www.auas-safarilodge.com/

The affected landowners remain concerned that the presence of the line will negatively affect sense of place, thus degrading and devaluing the experience for landowners, land users and visitor/ tourists. The line may be visible from some residences (private and tourist accommodation), and visible at times to people participating in eco-tourism and hunting activities. Opinions of the presence of the line will vary substantially.

Table 4-6 Operation Phase: Changed Sense of Place

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Changed Sense of Place										
Impact Description The visual intrusion resulting from the presence of the proposed transmission line during the operational phase may negatively affect the sense of place for some receptors in the Project area. The majority of the farms and receptors will only be marginally negatively affected by the proposed Project. The impact will be site specific (low) for the duration of the operational phase (high). The intensity will range considerably depending on the land use activity, the value placed on the visual landscape by individual receptors, and the associated expectations of each receptor. It is therefore expected that intensity will be low for the majority of affected receptors and high for a small number of receptors; notably some land owners/ users and some tourists. Local experience on Project affected farms and farms in the broader area have demonstrated that most tourists do not react negatively to the presence of existing transmission lines. Based on the extent, duration and intensity of the impact, the consequence is expected to range from low to high. There is a high probability that the impact will occur for some stakeholders. The impact on sense of place resulting from the visual intrusion of the line is assessed to be of LOW negative significance for the majority of receptors and of HIGH negative significance for some receptors. It is possible that overtime the high negative significance may decrease as the low vegetation regenerates and the memories of the farm pre-construction become more distant. Post mitigation, it will be difficult to reduce the significance rating given that the desired measure would be to not construct the line. Where the line can be shifted away from critical view sheds, the post-mitigation significance may be reduced to one of medium negative significance or lower (from high), depending on position.										

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
The specialists' degree of confidence is medium.										
Without Mitigation	Negative	Low	High	Low & High	Med	Low	Low & High	High	LOW & HIGH -	Med
Mitigation Measures **Pre-construction planning** • Implement pre-construction planning measures as proposed in Sections 4.2.2 and 4.2.3. **Generic operation phase management measures** • Implement all traffic, noise, dust, visual, safety, and personnel management measures as specified in the EMP. **Workforce management** • All staff will agree to a Code of Conduct (CoC) that outlines protocols and standards for working on the affected land. The CoC should address the following: o respect for local residents; o respect for existing livelihood activities and the environment; o no hunting, snaring or unauthorised taking of any property belonging to someone else; o compliance with the Traffic Management Plan and all associated regulations; o disciplinary measures for not adhering to the Code of Conduct. • If personnel are found to be in contravention of the CoC, which they are to sign at the commencement of their contract, they will face disciplinary procedures that could result in dismissal. Produce/ stock theft should be noted as a dismissible offence. • Implement an HIV/AIDS policy and information document for all personnel on the proposed Project. The information document will address factual health issues as well as behaviour change issues around the transmission and infection of HIV/AIDS. Condoms to be made available to employees and all contractors. **Ongoing engagement and grievance management** • Implement the grievance procedure as described in Section 4.2.1.										
With Mitigation	Negative	Low	High	Low & Med	Med	Low	Low & Med	High	LOW & MEDIUM -	Med
Cumulative Impact On many of the Project affected farms, there are already a number of transmission lines. The addition of a new line will exacerbate the already disturbed visual appearance of the area. Thus, the negative cumulative impact will be enhanced.										

4.3.3 Disruption to Farm Management

During the operational phase of the Project, it is expected that agriculture and tourism activities can continue uninterrupted. There will be 2 restrictions, however, structures (e.g. windmills, houses, lodges) cannot be built within the transmission line servitude and NamPower will require unhindered access to the servitude for line inspections and repairs, if required. NamPower personnel will undertake monitoring visits approximately every 3 years and on an *ad hoc* basis should the need arise. They will have keys to access the property as required. Some land owners highlighted concerns regarding NamPower accessing their farms without prior notification, presence of workers on the farms, use of and possible degradation/ erosion of farm roads, damage to fencing, risks of leaving gates open, and littering.

Many of the farmers make regular use of helicopters/ gyrocopters, and similar aircraft, to fly over the expansive areas as a farm management mechanism (e.g. they are used for animal counts, herding livestock, hunting activities, stock theft prevention). Already the conditions for flying are challenging, the addition of a transmission line will increase the risks of flying due to their poor visibility, especially in poor light conditions. In addition, the lines prevent the aircraft from flying close enough to the ground, therefore sterilising access to parts of the farm. NamPower will comply with all the civil aviation regulations and the line will be registered with the civil aviation authorities.

Some landowners consider construction of the access road to be a benefit for farm management as the road can be used by the farmers and it also serves as a fire break. The gates are also beneficial for the farmers.

Table 4-7 Operation Phase: Disruption to Farm Management

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Disruption to Farm Management										
Impact Description Disruption to farm management activities resulting from operational activities and the presence of the line is largely considered irrelevant to most farmers. However, some farmers are concerned about the presence of workers on their land, degradation of farm roads, risks linked to leaving gates open, damage to fencing, and litter. The most concerned farmers are those that make use of aircraft for farm management; they are concerned about the risks of flying. This is considered to be a negative impact. The impact will be experienced in the immediate proximity of the site (low extent) for the operational life of the line (long-term); as such the duration will be high. The intensity will be medium given that most activities will be able to continue in a modified manner. Based on the extent, duration and intensity of the impact, the consequence is expected to be medium. There is a high probability that the impact will occur. The disruption to farm management is assessed to be one of MEDIUM negative significance. Post mitigation, it may be possible to reduce the impact significance to one of medium-low negative significance. The specialists' degree of confidence is medium.										
Without Mitigation	Negative	Low	High	Med	Med	Low	Med	High	MEDIUM -	Med
Mitigation Measures **Pre-construction planning** • Implement pre-construction planning measures as proposed in Sections 4.2.2 and 4.2.3. **Operation phase management measures** • Implement all traffic, noise, dust, visual, safety, and personnel management measures as specified in the EMP. • Land owners/ users to be notified prior to NamPower arrival on site. Where this is not possible, NamPower to announce themselves when they arrive. • Planned maintenance and monitoring activities are to be scheduled during low tourist seasons. • Warning spheres are to be installed close to any landing strips.										

<table>
<tr><th>Impact</th><th>Nature</th><th>Extent</th><th>Duration</th><th>Intensity</th><th>Reversibility</th><th>Impact on Irreplaceable Resources</th><th>Consequence</th><th>Probability</th><th>Significance</th><th>Confidence</th></tr>
<tr><td colspan="11">Workforce management
• Implement all measures as proposed in Section 4.3.2.

Ongoing engagement and grievance management
• Develop and maintain an up-to-date stakeholder register to ensure that correct contact details are available.
• Develop and implement a Stakeholder Engagement Plan. Affected land owners/ users should be consulted regularly and kept up-to-date regarding activities that will directly affect them.
• Implement the grievance procedure as described in Section 4.2.1.</td></tr>
<tr><td>With Mitigation</td><td>Negative</td><td>Low</td><td>High</td><td>Med-Low</td><td>Med</td><td>Low</td><td>Med-Low</td><td>High</td><td>MEDIUM/ LOW -</td><td>Med</td></tr>
<tr><td colspan="11">Cumulative Impact

On many of the Project affected farms, there are already a number of transmission lines. The addition of a new line will exacerbate the disruptions already experienced by the land owners. Flying will become more risky and difficult as a farm management measure. Thus, the negative cumulative impact will be enhanced.</td></tr>
</table>

5 CONCLUSION

NamPower propose to construct a single-circuit 400 kV transmission power line from the Kokerboom Substation (near Keetmanshoop) to the Auas Substation (near Windhoek), a distance of approximately 500 km (the Project). The pylon (tower) height will be approximately 45 m and the distance between pylons approximately 500m. There are two existing transmission lines connecting the two substations, a 400 kV and a 220 kV line but this infrastructure alone is considered inadequate to meet the future demand needs of the country. The purpose of the proposed Project is to strengthen the overall transmission network in Namibia. It is proposed that the Project will be constructed in approximately 5 - 10 years' time (i.e. before 2026), and possibly earlier if the Kudu Gas Project comes on line earlier than is currently expected. Without upgrades to the transmission line network future electricity supply will become constrained in Namibia, and as a result, restrict development (mining, industrial and residential) and negatively impact quality of life in the country as a whole.

The proposed 400 kV transmission line traverses 3 regions (namely Khomas, Hardap and //Karas), and 7 constituencies (Windhoek Rural, Mariental Urban, Mariental Rural, Rehoboth Rural, Gibeon, Berseba, and Keetmanshoop Rural). Khomas region is one of the most densely populated regions of Namibia; it is home to the national capital, Windhoek. It is landlocked and centrally located in Namibia. Hardap and //Karas regions are geographically extensive regions with low levels of population density; large parts of these regions comprise the Namib and Kalahari deserts.

The Project area is defined by low population densities, high levels of poverty, relatively low levels of access to infrastructure, and poor quality rangelands (low carrying capacity is linked to the arid climate and poor agricultural practices, particularly along the southern section of the line). Livestock agriculture is the most dominant economic sector in the proposed Project area. The majority of the employed population derive income as employees (i.e. private, commercial agriculture and government). There are 89 affected farms, they are predominantly owned privately (freehold tenure) or by the state and used as communal land. There are no formal settlements located within the proposed 500 m corridor. The area is used for grazing (domesticated livestock and game) and some eco-tourism and hunting activities. There are some private residences and tourist facilities located in close proximity to the proposed transmission line.

The transmission line route has been revised to avoid impacts on existing infrastructure, as far as possible. NamPower identified a suitable routing option for the transmission line with input from the environmental consultants and relevant specialists. The realignment has already served to avoid and reduce potential negative impacts of the proposed Project on socio-economic receptors (notably infrastructure).

The impacts identified during the construction and operational phases of the Project are presented in **Table 5-1**.

Table 5-1 Summary of impact significance, pre- and post-mitigation

Impact	Nature	Extent	Duration	Intensity	Reversibility	Impact on Irreplaceable Resources	Consequence	Probability	Pre-Mitigation Significance	Post-Mitigation Significance	Confidence
Construction:											
Employment and procurement	Positive	High	Low	Low	N/A	N/A	Low	High	LOW +	LOW-MEDIUM +	Med
Disruption of livelihood activities and lifestyles	Negative	Low	Low	Low-Med	N/A	N/A	Low	High	LOW-MED -	LOW -	Med
Destruction or disruption of homesteads and farm infrastructure	Negative	Low	Low	Low	N/A	N/A	Low	High	LOW -	LOW-VERY LOW -	Med
Operation:											
Benefits for the economy	Positive	High	High	Low	High	N/A	Med	Low-Med	LOW-MED +	LOW-MEDIUM +	Med
Changed sense of place	Negative	Low	High	Low / High	Med	Low	Low / High	High	LOW / HIGH -	LOW & MEDIUM -	Med
Disruption to farm management	Negative	Low	High	Med	Med	Low	Med	High	MEDIUM -	MEDIUM-LOW -	Med

The positive impact associated with the construction and operation of the proposed transmission line is the improved transmission network nationally. This impact may serve to enhance the economy as commercial and private electricity provision becomes more reliable and consistent potentially enabling business enhancements and a generally better quality of life. Some direct, indirect and induced employment opportunities will be created by the Project itself and through procurement spend. Benefits will be limited in the local area as the successful contractor (origin still to be determined through an open tender process) is likely to use skilled workers that are already known and trusted by them. Some short-term contract employment should be available to local people.

The negative impacts linked to the proposed Project will be localised and will affect land owners, land users and tourists in different ways. Existing agricultural activities will largely be able to continue unhindered during the construction and operation processes. Some planning will be required to minimise disruptions during construction. Tourism activities may be more sensitive to the construction phase nuisance factors and the visual intrusion of the line during the operational phase; these could impact on the sense of place for some receptors. Where the line is visible, specifically from private residences, some of the land owners and users may also experience a negative effect on sense of place. Not all tourists and land owners will respond in the same way to the existence of the line; local experience indicates that existing lines have not affected tourism or sense of place for most receptors.

The presence of transmission lines affects the ease with which helicopters/ gyrocopters (and similar aircraft) can fly over the farms. These aircraft are used by a small number of farmers as a means of managing farming activities. Flying becomes increasingly risky as a result of the lines due to low visibility and an inability to fly close to the ground in areas where lines are present. The addition of this proposed line will negatively affect farm management for some farmers.

The cumulative visual impact and hence the impact on sense of place, and the cumulative impact on disruption to farm management - resulting from the addition of the proposed transmission line - will exacerbate the already negative impacts experienced as a result of existing lines for some receptors.

Based on the Project information available and the socio-economic conditions, it is the reasoned opinion of the social specialist that the proposed Project should be authorised on condition that the stipulated mitigation measures are implemented.

6 REFERENCES

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RoN. 2014. 2011 Population and Housing Census: //Karas Regional Profile, Basic Analysis with Highlights. National Planning Commission.

RoN. 2014. 2011 Population and Housing Census: Khomas Regional Profile, Basic Analysis with Highlights. National Planning Commission.

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World Travel and Tourism Council. 2015. Travel and Tourism Economic Impact 2015 Namibia.

Websites showing local tourism:

www.auas-safarilodge.com
www.hohewarte.com

6.1 Personal Communication

Berseba Rural Constituency: Hon. Dawid Boois, Councillor (30/09/2016).

Farm Klipvlei, Windhoek Rural: Mrs L. Christ (12/10/2016).

Farm Koichas, Mariental Rural: Mr H. Simon (30/09/2019).

Farm Langverwag, Hardap: Incorrect landowner – need to identify Mr Coetzee (30/09/2016).

Farm Nunniboom, Mariental Rural: Mr Dirk van Zyl, farm sold to government (30/09/2016).

Farm Voigtland, Windhoek Rural: Mr Voigts (30/09/2016).

Groenvlakt and Ptn of Farm Groenveld-East, Rehoboth Rural: Mr P. Block, lease (11/10/2016).

Hohenau, Windhoek Rural: Mr R. Halenke (04/10/2016).

Hohewarte, Windhoek Rural: Mr Batz (06/10/2016).

Hohewarte, Windhoek Rural: Mr H. Halenke (05/10/2016).

Mertens, Windhoek Rural: Mr K. Welsch Jr. (11/10/2016).

NamPower: Mr Danie Louw and Mr Calvin Sisamu, Environmental Management (03/10/2016).

NamPower: Mr Gideon van den Berg, Technical Officer (8, 21, 22 July 2015).

Nunniboom, Mariental Rural: Mr A. Engelbrecht (24/10/2016).

Ptn 2 and 3 of Duineveld, Rehoboth Rural: Mr Raymund Maasdorp (03/10/2016).

Ptn. 2 of Klein Spitskop and Klein Spitskop (Rem. Ext), Keetmanshoop Rural: Mr J. Olivier (03/10/2016).

Rehoboth Town Council: Mr Kasupi (04/10/2016).

Rehoboth Town Council: Mr M. Beukes, Electricity Department (03/10/2016).

Rem. of Atsigas Noord, Rehoboth Rural: Mr N. Celento (13/10/2016).

Rem of Farm Hamis, Windhoek Rural: Ms. U. Stellmacher (03/10/2016).

Rem of Gravenstein, Windhoek Rural: Mr Rottcher (06/10/2016).

Rem of Lekkerwater, Windhoek Rural: Mr W. Skutsch (30/09/2016.

Rem. of Ptn. 5 of Orab, Mariental Rural: Mr L. M. Leeb (03/10/2016).

RoN, Ministry of Land Reform. Farms owned by the Government of Namibia, affected by the NamPower Kokerboom to Auas Transmission Line in //Kharas Region. Letter dated 16/09/2016.

RoN, Ministry of Land Reform: Mr A. Engelbrecht, Deputy Director and //Kharas Regional Representative (24/10/2016 and 25/10/2016).

Tses Village Council: Mr A. Goliath, Chairperson (28/09/2016).

Tses Village Council: Hon. I. Vries, CEO (29/09/2016).

Wilderness Rem Ptn, Mariental Rural: Mr C. Smith (11/10/2016).

APPENDIX 1:
CURRICULUM VITAE OF
KERRYN MCKUNE-DESAI

KERRYN MCKUNE DESAI

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SOCIO-ECONOMIC DEVELOPMENT SPECIALIST

Kerryn offers fifteen years of experience in the fields of socio-economic development and social performance in corporate, non-profit and academic environments. Her social capabilities draw on in-depth knowledge of the International Finance Corporation (IFC) Performance Standards and Equator Principals. She has diverse sector expertise, with specific focus in the mining, oil and gas, and power/ renewable energy sectors. She has worked throughout Africa, including South Africa, Botswana, Uganda, Cameroon, Ghana, Nigeria, Tanzania, Guinea, Zambia, São Tomé and Príncipe, as well as Albania and Turkey.

Areas of most relevant work experience include social impact assessment (SIA), social risk identification and assessment, resettlement planning, and stakeholder engagement planning and implementation. Much of her work has involved complex SIAs for large-scale projects, including transmission lines.

CAREER HISTORY

April 2014 – current	Self-employed: Social Consultant
Nov 2005 - March 2014	Environmental Resources Management (ERM): Principal Consultant
Jul 2003 - Nov 2005	The Non-Profit Consortium: Development Officer & Researcher
Feb 2000 - Aug 2001	Disaster Mitigation for Sustainable Livelihoods Programme, UCT: Risk Reduction Researcher

HIGHER EDUCATION

Masters (Arts)**:**	University of London, Royal Holloway - Geography and Development (2001/2002)
Honours BA (Hons)**:**	University of Cape Town - Environmental & Geographical Science (1999)
Undergrad (SocSc)**:**	University of Cape Town - Environmental & Geographical Science, Social Anthropology, and Archaeology (1995 – 1998)
Other:	University of South Africa - Microeconomics, Business Management, and Marketing Research (2003-2006)

SELECTED PROJECT EXPERIENCE

Social Impact Assessment, South Africa, Siyanda Chrome Smelting Company, 2016
Social specialist for a Social Impact Assessment for a ferrochrome smelter located near Northam in Limpopo Province.

Social Impact Assessment, South Africa, Wesizwe, 2015-2016
Social Specialist for a Social Impact Assessment of an amendment to an approved platinum mine in North West Province.

Specialist Comment (Amendment) and Social Impact Assessment, South Africa, Mainstream, 2015-2016
Social Specialist providing comment for a proposed amendment and SIA for additional infrastructure on already authorised renewable energy facility near Beaufort West in the Western Cape Province.

Social Impact Assessment, South Africa, Platinum Waste Resources, 2014
Social Specialist for a Social Impact Assessment (SIA) of Klinkerstene Clay Mine near Delmas in Mpumalanga Province, South Africa.

Social Impact Assessment, South Africa, ACSA, 2014
Developed the Socio-economic Impact Assessment for the realignment of the runway at Cape Town International Airport.

Resettlement Strategy Development, South Africa, Platreef Resources, 2013-2014
Project Manager for the development of a Resettlement Strategy to guide the upcoming Resettlement Action Plan development process for economic and physical displacement. Project undertaken in terms of IFS Performance Standards.

Resettlement Action Plan, South Africa, Anglo American Platinum, 2012 - 2013
Project Manager for the development of a Resettlement Action Plan for the Motlhotlo community located near Mokopane in the Limpopo Province.

Social Impact Assessment, South Africa, Black Mountain Mining, Zinc Mine Project, 2012 - 2013
Social advisor and reviewer for the Social Impact Assessment and Management Plan for a proposed Zinc Mine Project in South Africa's Northern Cape Province.

Environment and Social Compliance Review, Proparco/ Norfund on behalf of Confidential Client, Mozambique, Uganda, Zambia and Zimbabawe, 2012
Social Specialist for an IFC compliance review of the Environmental and Social Impact Assessment (ESIA), Management Plans and Licenses for a number of proposed agri-businesses.

Environmental and Social Management Plan, Botswana, Sasol CBM, 2012
Project Manager for the development of a high-level baseline, assessment and social management plan for an early exploration coalbed methane drilling Project.

Social Impact Assessment and Community Engagement, Ghana, Tullow Ghana Limited, 2012
Project Manager for the Social Impact Assessment and community level consultations for offshore exploration drilling. IFC compliant project.

Social Impact Assessment, Guinea, Rio Tinto, 2011-2012
Specialist assessment of the socio-economic impacts associated with the development of a mine, rail and port in Guinea. IFC compliant project; IFC was a partner and key funder.

Development of Anglo American's Socio-Economic Assessment Toolbox (SEAT), 2008 and 2012
Part of team that developed SEAT; a comprehensive guidance document to provide support to Operations wanting to assess and improve social performance at Anglo American operations.

Stakeholder Engagement Strategy, South Africa, Anglo American Thermal Coal (AATC), 2011
Project Manager for the development of a Stakeholder Engagement Strategy for a proposed coal mine located within the bufferzone of a World Heritage Site, Mapungubwe.

Resettlement Need Assessment and Gap Analysis, Abuja, Nigeria, Houses for Africa, 2010
Project Manager for a scoping visit to assess the extent of resettlement required and the work undertaken to date. Advised the client what activities were required to develop an IFC compliant Resettlement Action Plan.

Social Impact Assessment for seismic surveys, Cameroon, Kosmos, 2008 -2009
Lead Social specialist for Social Impact Assessment and community level consultations for exploration seismic surveys. Managed team of international and local social consultants for IFC aligned project.

Social Impact Assessment for Transmission Line, Cameroon, AES Sonel, 2008
Lead Social specialist for Social Impact Assessment and community level consultations for 113km transmission line. Managed team of international and local social consultants for IFC aligned project.

Other projects:

- Environmental and Social Due Diligence of the Proposed Coega Wind Energy Project, South Africa, Electrawind, 2011
- Social Impact Assessment, Albania, Trans-Adriatic Pipeline (TAP), 2011
- Socio-Economic Assessment Toolbox (SEAT) Training, South Africa, Various, 2006-2012
- Social Impact Assessments for 5 Wind Farms, Western and Northern Cape, South Africa, G7 Renewable Energies, 2010
- Social Impact Assessment for 8 Renewable Energy Facilities, Western and Northern Cape, South Africa, Mainstream Renewable Power South Africa, 2010
- Social Baseline, Risk Assessment and Engagement Plan, Botswana, AngloCoal, 2009 - 2010
- Reputational Risk Assessment, South Africa, Confidential Client, 2009
- Social Impact Assessment for a Gold Mine, Turkey, Anatolia Development Minerals Limited, 2009
- Social Baseline, Risk Assessment and Engagement Plan, South Africa, AngloCoal, 2008 - 2009
- Development of Exploration Phase Guidance Documents, South Africa, AngloCoal, 2008 - 2009
- Socio-Economic Overview and Key Risk Identification, Tanzania, Confidential Client, 2008
- Socio-Economic Impact Assessment for Offshore Exploration Drilling and an Early Production System in Lake Albert, Uganda, Tullow Oil, 2007 – 2008
- Social Audits for table grape farms, Kakamas, Fairfood, 2007

APPENDIX 2:
DETAILS OF DIRECTLY AFFECTED FARMS

Farm details as retrieved from the Surveyor General (May 2016) and adapted based on personal interviews (October 2016)

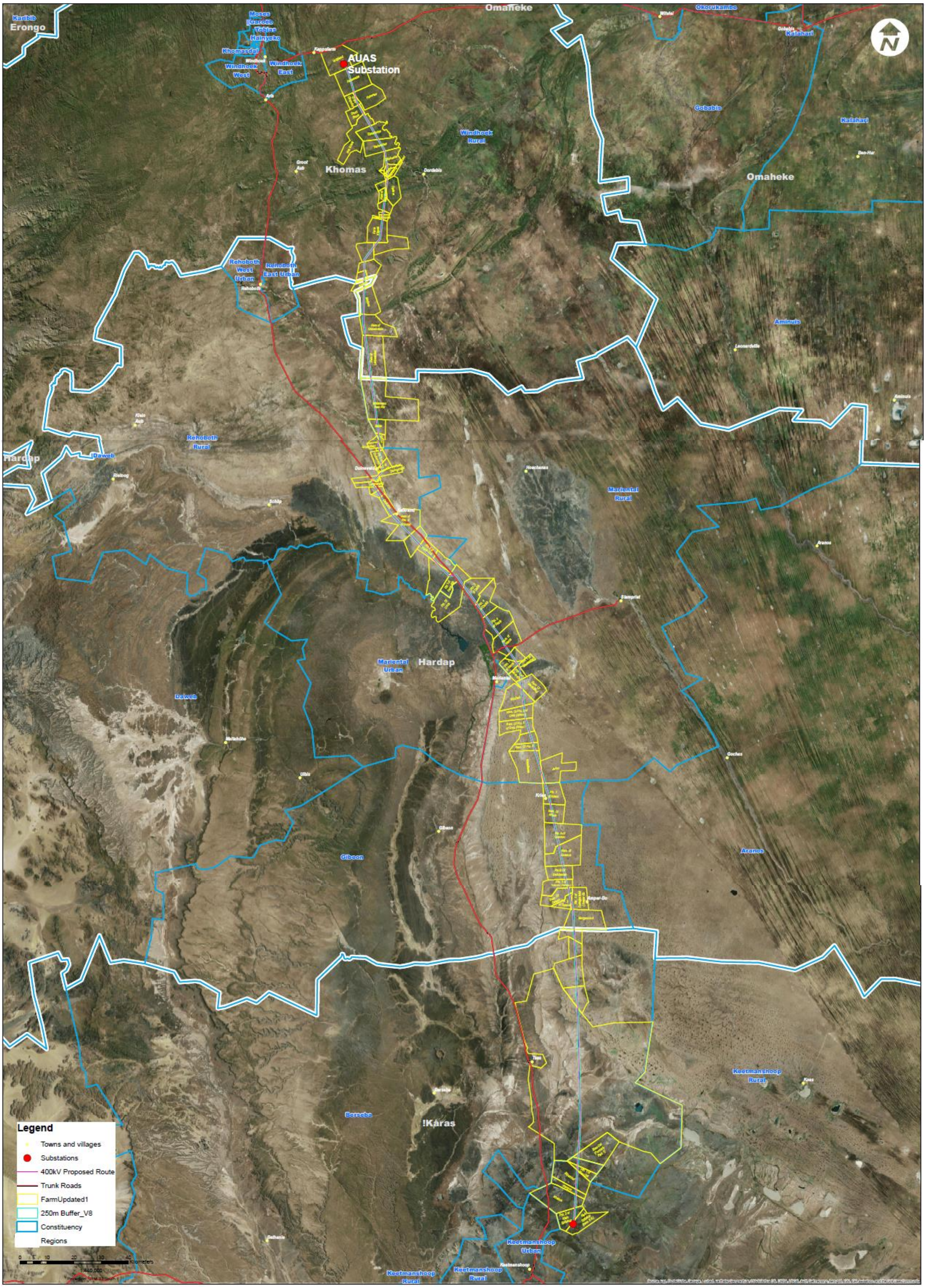
FARM NAME NEW	FARM HA	FARM OWNER	FARM NO NEW	FARM NO	OWNERSHIP	NATIONALITY	REGION	CONSTITUENCY
Elisenhohe	5587,1016	Klaus Eberhard Biederlack	FMK/00088	88	IND	NAMIBIAN	Khomas	Windhoek Rural
Evita	110,0001	Hendrik Jacobus Bernadus January	FMM/00736	736	IND	NAMIBIAN	Khomas	Windhoek Rural
Farm Klipvlei	6013,0882	W.F. Christ en Vennote	FMM/00278	278	IND		Khomas	Windhoek Rural
Farm Waldburg	497,2502	Daniel Edward Korner	FMM/00735	735	IND	NAMIBIAN	Khomas	Windhoek Rural
Groot Brack	2982,3084	Stephanus Jacquelin Gous	FMK/00438	438	IND	NAMIBIAN	Khomas	Windhoek Rural
Gross Okapuka	2806,6103	Gubiani Family (Pty) LTD	FMK/00456	456	(PTY) LTD	NAMIBIAN	Khomas	Windhoek Rural
Hohenau	6610,8846	Mr Ryna Halenke	FMK/00081	81	IND	NAMIBIAN	Khomas	Windhoek Rural
Hohewarte	10157,8720	Alfred Oetker	FMK/00076	76	(PTY) LTD	GERMAN	Khomas	Windhoek Rural
Mertens	6696,8280	Kurt Welsch	FMM/00063	63	IND		Khomas	Windhoek Rural
Neu Brack	8218,7795	Hermann Gerhard Romeis	FMK/00454	454	IND	NAMIBIAN	Khomas	Windhoek Rural
Opdam	96,2205	Ms. M De Bruyn	FMM/00284	284	IND	NAMIBIAN	Khomas	Windhoek Rural
Rem of farm Hamis	96,0917	Fawzia Stellmacher	FMM/00280/00REM	280	IND	NAMIBIAN	Khomas	Windhoek Rural
Rem of Gravenstein	7560,7916	Mr Rottcher and Mr Traut	FMM/00065	65	IND		Khomas	Windhoek Rural
Rem of Lekkerwater	12486,3955	Amulf Winfried Schnabel	FMM/00143/00REM	143	IND	NAMIBIAN	Khomas	Windhoek Rural
Stinkwater	235,0000	Frederik Cloete	FMM/00282	282	IND	NAMIBIAN	Khomas	Windhoek Rural
Swartkoppies	163,1375	Estate of the Late Christiaan Dick	FMM/00279/00006	279	IND	NAMIBIAN	Khomas	Windhoek Rural
Tsatsachas	5777,9992	Richard Rieder	FMK/00087	87	IND	NAMIBIAN	Khomas	Windhoek Rural
Voigtland	7568,4083	Heinrich Gustav Stephen Voigts	FMK/00472	472	IND	NAMIBIAN	Khomas	Windhoek Rural
Volmoed	963,4240	Johanna Mowes	FMM/00720	720	IND	NAMIBIAN	Khomas	Windhoek Rural
Waldburg	55,7143	Theodore Gideon Korner	FMM/00734	734	IND	NAMIBIAN	Khomas	Windhoek Rural
SWARTKOPPIES			FMM/00279/00003	279	COMPANY	NAMIBIAN	Khomas	Windhoek Rural
SWARTKOPPIES			FMM/00279/00005	279	COMPANY	NAMIBIAN	Khomas	Windhoek Rural
HAMIS			FMM/00280/00002	280	IND	NAMIBIAN	Khomas	Windhoek Rural
			FMM/00450/00REM	450	COMPANY	NAMIBIAN	Khomas	Windhoek Rural
EMMABRON			FMM/00875	875	IND	NAMIBIAN	Khomas	Windhoek Rural

FARM			FMM/00881/00003	881	IND	NAMIBIAN	Khomas	Windhoek Rural
DANIGAS			FMM/00289/00001	289	COMPANY	NAMIBIAN	Khomas	Windhoek Rural
DANIGAS			FMM/00289/00REM	289	IND	NAMIBIAN	Khomas	Windhoek Rural
Denksrus	2000,0182	Hans Gerhardt Denk	FMM/00444/00001	444	IND	NAMIBIAN	Hardap	Rehoboth Rural
Groenvlakt	911,5173	Monray Denzel Diergaardt	FMM/00650	650	IND	NAMIBIAN	Hardap	Rehoboth Rural
Kameel Doringmund	0,0000	Agnes Beukes	FMM/00704	704	IND	NAMIBIAN	Hardap	Rehoboth Rural
Ptn 1 of Farm 650	2588,5594	Christo Bindeman	FMR/00650/00001	650	IND		Hardap	Rehoboth Rural
Ptn 2 of Duineveld	1396,2499	Raymund Louis Maasdorp	FMM/00437/00002	437	IND	NAMIBIAN	Hardap	Rehoboth Rural
Ptn 3 of Duineveld	2374,8091	Raymund Louis Maasdorp	FMM/00437/00003	437	IND	NAMIBIAN	Hardap	Rehoboth Rural
Ptn 2 of Narib Oos	2950,5441	Christian Jacobus de Klerk	FMR/00602/00002	602	IND		Hardap	Rehoboth Rural
Ptn of farm Groenveld - East	450,0872	Monray Denzel Diergaardt	FMM/00429	429	IND	NAMIBIAN	Hardap	Rehoboth Rural
Ptn. 1 of Langverwag	0,1050	Johan Maasdorp	FMM/00442/00001	442	IND	NAMIBIAN	Hardap	Rehoboth Rural
LANGVERWAG			FMM/00442/00REM	442	IND	NAMIBIAN	Hardap	Rehoboth Rural
Rem of Ptn. 4 of Gurus	0,5807	SWA Property Holdings and Investment (Pty) Ltd	FMM/00150	150	GOV	NAMIBIAN	Hardap	Rehoboth Rural
Rem. Of Atsigas Noord	2150,1300	Catharina Johanna Celento	FMM/00757/00REM	757	IND	NAMIBIAN	Hardap	Rehoboth Rural
OAS			FMM/00443/00002	443	IND	NAMIBIAN	Hardap	Rehoboth Rural
OAS			FMM/00443/00003	443	IND	NAMIBIAN	Hardap	Rehoboth Rural
NARIB OOS		Government of Namibia	FMR/00602/00REM	602	GOV	NAMIBIAN	Hardap	Rehoboth Rural
			FMM/00437/00REM	437	COMPANY	NAMIBIAN	Hardap	Rehoboth Rural
GURUS			FMR/00006/00001	6	(PTY) LTD	NAMIBIAN	Hardap	Rehoboth Rural
Farm 650		Dr Louise Burger	FMR/00650/00REM	650	IND		Hardap	Rehoboth Rural
Ptn. Of Urrub	400,3935	Jurgens Oberholzer	FMR/00107	107	(PTY) LTD		Hardap	Mariental Urban
Battle	4227,1956	Jacobus Johannes & Maria Johanna Smith	FMM/00947	947	IND		Hardap	Mariental Rural
Battle	4227,1956	Jacobus Johannes & Maria Johanna Smith	FMM/00947	947	IND		Hardap	Mariental Rural
Jerico	6723,4718	Albertus Jacobus De Waal	FMR/00667	667	GOV		Hardap	Mariental Rural
Koichas		Herbert Heinrich Simon	FMR/00089	89			Hardap	Mariental Rural
Nunniboom	10685,0194	Government of Namibia	FMR/00216	216	GOV		Hardap	Mariental Rural

Ptn. 1 of Marienthal	2132,5081	Pronto Farming CC	FMR/00086/00001	86	IND		Hardap	Mariental Rural
Ptn. 1 of Marienthal	2132,5081	Pronto Farming CC	FMR/00086/00001	86	IND		Hardap	Mariental Rural
Ptn. 1 of Narris	2439,1435	Mr. H B Simon	FMR/00111/00001	111	(PTY) LTD		Hardap	Mariental Rural
Rem. of Narris	7861,1232	Mr. H B Simon	FMR/00111/00REM	111	COMPANY		Hardap	Mariental Rural
Ptn. 3 of Dabib	5727,5067	Ernst Petrus Kuhlmann	FMR/00112/00003	112	LTD	NAMIBIAN	Hardap	Mariental Rural
Ptn. 4 of Dabib	5727,5269	Ernst Petrus Kuhlmann	FMR/00112/00REM	112	IND	NAMIBIAN	Hardap	Mariental Rural
Ptn. 4 of Dabib	5727,5269	Ernst Petrus Kuhlmann	FMR/00112/00004	112	IND		Hardap	Mariental Rural
Rem. Of Marienthal	5841,8232	Gert Van Wyk	FMR/00086/00REM	86	IND		Hardap	Mariental Rural
Rem. Of Ptn. 5 of Orab (Ritten)	5728,3781	Louis Mercer Leeb	FMR/00088/00005	88	IND		Hardap	Mariental Rural
Rem. Of Ptn. 5 of Orab (Ritten)	5728,3781	Louis Mercer Leeb	FMR/00088/00006	88	IND		Hardap	Mariental Rural
Rem. Of Ptn. 8 Orab	10114,0921	Government of Namibia	FMR/00088/004/2	88	GOV	NAMIBIAN	Hardap	Mariental Rural
Wilderness Rem Ptn	21125,4031	Tsumis Estate Farming (Pty(Ltd	FMM/00538	538	(PTY) LTD		Hardap	Mariental Rural
			FMR/00088/00REM	88	COMPANY		Hardap	Mariental Rural
NARRIS		Mr. H B Simon	FMR/00111/00007	111	IND		Hardap	Mariental Rural
Morgenrood	9940,7512	Government of Namibia	FMR/00238	238	GOV	NAMIBIAN	Hardap	Gibeon
Ptn. 1 of Kriess	5799,9995	Government of Namibia	FMR/00219/00001	219	GOV	NAMIBIAN	Hardap	Gibeon
Ptn. 1 of Salami (Mispa)	4923,7669	Government of Namibia	FMR/00239/00001	239	GOV	NAMIBIAN	Hardap	Gibeon
Ptn. 1 of Springbokvlei (Amper-Bo)	4746,7619	Government of Namibia	FMR/00237/00001	237	GOV	NAMIBIAN	Hardap	Gibeon
Ptn. 2 of Salami	2184,8179	Government of Namibia	FMR/00239/00002	239	GOV	NAMIBIAN	Hardap	Gibeon
Ptn. A of Goamus	10379,5935	Government of Namibia	FMR/00070/0000A	70	GOV	NAMIBIAN	Hardap	Gibeon
Ptn.B Of Garichanab	4796,6077	Government of Namibia	FMR/00067/0000B	67	GOV	NAMIBIAN	Hardap	Gibeon
Rem. of Goamus	10384,1156	Government of Namibia	FMR/00070/00REM	70	GOV	NAMIBIAN	Hardap	Gibeon
Rem. Of Kriess	5073,9253	Government of Namibia	FMR/00219/00REM	219	GOV	NAMIBIAN	Hardap	Gibeon
Rem. Of Salami	4452,8024	Government of Namibia	FMR/00239/00REM	239	GOV	NAMIBIAN	Hardap	Gibeon
Blau-Ost (Formerly Parz 1)	10,1570	Government of Namibia	FMT/00143	143	GOV	NAMIBIAN	!Karas	Berseba
		Government of Namibia	FMT/00015/002/1	15	GOV	NAMIBIAN	!Karas	Berseba
		Government of Namibia	FMT/00015/003/1	15	GOV	NAMIBIAN	!Karas	Berseba
			FMT/00015/00REM	15	COMPANY		!Karas	Berseba

		Government of Namibia	FMT/00020/00002	20	GOV	NAMIBIAN	!Karas	Berseba
TSES RESERVE		Government of Namibia	FMT/00169	169	GOV	NAMIBIAN	!Karas	Berseba
Bloemhof	9402	Government of Namibia	FMT/00311	311	GOV	NAMIBIAN	!Karas	Keetmanshoop Rural
Kangus	5788	Government of Namibia	FMT/00160	160	GOV	NAMIBIAN	!Karas	Keetmanshoop Rural
Khabus	12483	Government of Namibia	FMT/00146	146	GOV	NAMIBIAN	!Karas	Keetmanshoop Rural
Klein Spitskop (Rem. Ext.)	5788	Jacobus Barend Olivier	FMT/00153/00REM	153	IND	NAMIBIAN	!Karas	Keetmanshoop Rural
Ptn. 2 of Klein Spitskop	4727	Jacobus Barend Olivier	FMT/00153/00002	153	IND		!Karas	Keetmanshoop Rural
Ptn. 1 of Blau Ost	2158	Government of Namibia	FMT/00144/00001	144	GOV	NAMIBIAN	!Karas	Keetmanshoop Rural
		Government of Namibia	FMT/00REM	0	GOV	NAMIBIAN	!Karas	Keetmanshoop Rural

Locality Map and Affected Farms



APPENDIX 3:
IMPACT ASSESSMENT METHODOLOGY

The objective of the detailed impact assessment, in the context of this Environmental Impact Assessment (EIA), is to formally assess all the significant environmental impacts that may arise as a result of the proposed activities, in terms of the following criteria:

a. Nature of the impact

The type of effect the construction and operation of the proposed transmission power line development would have on the affected environment - positive, negative or neutral.

b. Extent of the impact

The spatial scale at which the impact will occur - local or at a large (e.g. regional) scale. Where possible, a quantification of the extent (e.g. in hectares) of the impact is given.

c. Duration of the impact

The lifespan of the impact - short-term (months), medium-term (years), long-term (decades) or permanent (human life time).

d. Intensity

Relative evaluation within the context of all the activities and the other impacts within the framework of the proposed transmission power line project. Does the activity destroy an element of the environment, alter its functioning, or render it only slightly altered? The assessment attempts to quantify the magnitude of the impacts and outline the rationale used.

e. Reversibility

The ability of the impacted environment to return to its pre-impacted state once the cause of the impact has been removed.

f. Irreplaceability

A description of whether the activity would have an impact on a resource / feature that is essentially irreplaceable

g. Consequence

The consequence of the potential impacts is determined according to the main criteria for determining the consequence of impacts, namely the extent, duration and intensity of the impacts.

h. Probability of occurrence

Description of the probability of the impact actually occurring and is described as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of any prevention measures).

i. Significance

The overall significance of the impacts is defined based on the result of a combination of the consequence rating and the probability rating, as defined above. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented or whether the resource is irreplaceable and/or the activity has an irreversible impact.

j. Degree of confidence in predictions

The degree of confidence (low, medium or high) that the EAP/ technical specialist has in the predictions made for each impact, based on the available information and level of knowledge and expertise.

k. Cumulative impacts

Incremental impacts of the activity and other past, present and future activities on a common resource.

The result of the above assessment methodology will be linked to recommendations for decision-making by the competent authority, the Ministry of Environment and Tourism, in the following manner:

Low – will not have an influence on the decision to proceed with the proposed transmission power line project, if recommended mitigation measures to mitigate impacts are implemented;
Medium – should influence the decision to proceed with the proposed transmission power line project, provided that recommended measures to mitigate impacts are implemented; and
High – would strongly influence the decision to proceed with the proposed transmission power line project regardless of mitigation measures.

The table overleaf provides a summary of the criteria and the rating scales used in the Impact Assessment.

Summary of the criteria and the rating scales that were used

Criteria	Rating Scales	Notes
Nature	**Positive**	This is an evaluation of the type of effect the construction, operation and management of the proposed transmission power line development would have on the affected environment. Would it be positive, negative or neutral?
	Negative	
	Neutral	
Extent This refers to the spatial scale at which the impact will occur.	**Low**	Site-specific, affects only the development footprint
	Medium	Local (limited to the site and its immediate surroundings, including the surrounding towns and settlements within a 10 km radius)
	High	Regional (beyond a 10 km radius) to national
Duration	**Low**	Short-term: 0 - 5 years, typically impacts that are quickly reversible within the construction phase of the project
	Medium	Medium-term, 6 - 10 years, reversible over time
	High	Long-term, 10 - 60 years, and continue for the operational life span of the development
Intensity This is a relative evaluation within the context of all the activities and the other impacts within the framework of the proposed transmission power line project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered? The studies attempt to quantify the magnitude of the impacts and outline the rationale used.	**Low**	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected
	Medium	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected
	High	Where natural, cultural or social functions and processes are altered to the extent that the impact will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected
Degree of Reversibility This considers the ability of the impacted environment to return to its pre-impacted state once the cause of the impact has been removed.	**Low**	Impacted natural, cultural or social functions and processes will return to their pre-impacted state within the short-term
	Medium	Impacted natural, cultural or social functions and processes will return to their pre-impacted state within the medium to long term
	High	Impacted natural, cultural or social functions and processes will never return to their pre-impacted state
Potential for impact on irreplaceable resources This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could possibly be replaced by natural processes (e.g. by natural colonisation from surrounding areas), through artificial means (e.g. by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems substitutes are often possible. In contrast, red data species that are restricted to a particular site or habitat of very limited extent are likely irreplaceable.	**Low**	No irreplaceable resources will be impacted
	Medium	Resources that will be impacted can be replaced, with effort
	High	There is no potential for replacing a particular vulnerable resource that will be impacted
Consequence The consequence of the potential impacts is a summation of above criteria, namely the extent, duration, intensity and impact on irreplaceable resources.	**Low**	A combination of any of the following: • Intensity, duration, extent and impact on irreplaceable resources are all rated low • Intensity, duration and extent are rated low but impact on irreplaceable resources is rated medium to high • Intensity is low and up to two of the other criteria are rated medium • Intensity is medium and all three other criteria are rated low
	Medium	• Intensity is medium and one other criteria is rated high, with the remainder being rated low

Criteria	Rating Scales	Notes
		• Intensity is low and at least two other criteria are rated medium or higher • Intensity is rated medium and at least two of the other criteria are rated medium or higher • Intensity is high and at least two other criteria are medium or higher • Intensity is rated low, but irreplaceability and duration are rated high
	High	• Intensity and impact on irreplaceable resources are rated high, with any combination of extent and duration • Intensity is rated high, with all of the other criteria being rated medium or higher
Probability The probability of the impact actually occurring based on professional experience of the technical specialist/ EAP with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between probability of the **impact** occurring and probability that the **activity causing a potential impact** will occur. <u>Probability is defined as the probability of the impact occurring</u>, not as the probability of the activities that may result in the impact. The fact that an activity will occur does not necessarily imply that an impact will occur.	**Low**	Improbable. It is highly unlikely or less than 50 % likely that an impact will occur
	Medium	Distinct possibility. It is between 50 and 70 % certain that the impact will occur
	High	Most likely. It is more than 75 % certain that the impact will occur or it is definite that the impact will occur
Significance Impact significance is defined to be a combination of the consequence (as described below) and probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) is evaluated in terms of the <u>seriousness (consequence) of the impact, weighted by the probability of the impact actually occurring</u>. If the consequence **and** probability of an impact is high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.	**Low**	• Low consequence and low probability • Low consequence and medium probability • Low consequence and high probability
	Low to medium	• Low consequence and high probability • Medium consequence and low probability
	Medium	• Medium consequence and low probability • Medium consequence and medium probability • Medium consequence and high probability • High consequence and low probability
	Medium to high	• High consequence and medium probability
	High	• High consequence and high probability
Degree of confidence in predictions Technical specialists/ EAP provide an indication of the degree of confidence (low, medium or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. Degree of confidence is not taken into account in the determination of consequence or probability.	**Low** **Medium** **High**	