Nkurenkuru
ECOLOGY & BIODIVERSITY

OLIFANTSHOEK 132KV POWER LINE, NORTHERN CAPE PROVINCE

AVIFAUNA STUDY AND ASSESSMENT

Version: 1.0

Date: 18th JUNE 2020

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PROPOSED CONSTRUCTION OF THE OLIFANTSHOEK 132KV POWER LINE, NORTHERN CAPE PROVINCE

Report Title: Avifauna Study and Assessment

Authors: Mr. Gerhard Botha

Project Name: Proposed construction of the Olifantshoek 132KV Power Line, Northern Cape Province

Status of report: Version 1.0

Date: 18th June 2020

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I. DECLARATION OF CONSULTANTS INDEPENDENCE

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offense in terms of regulation 48 of GN No. R. 326.

REPORT AUTHORS

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June 2020

II. REQUIREMENTS REGARDING A SPECIALIST ASSESSMENT

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Sections where this is addressed in the Specialist Report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page I and Appendix 2 & 3
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page I
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 2 and Section 5
g) an identification of any areas to be avoided, including buffers;	N/A
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 3 and 4
k) any mitigation measures for inclusion in the EMPr;	Section 5
l) any conditions for inclusion in the environmental authorisation;	Section 5
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 5
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 6
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A

q) any other information requested by the competent authority.	N/A
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

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ECOLOGY AND FRESHWATER RESOURCE STUDY AND ASSESSMENT

1. INTRODUCTION

Applicant

Gamagara Local Municipality

Project

The project will be known as the Olifantshoek 132kV Power Line.

Proposed Activity

The Olifantshoek power line will be comprised of the following:

» A new **overhead** 132 kV **power line** approximately 36 km long to connect the Emil Switching Station to the new Olifantshoek Substation (soon to be constructed).

The table below (Table 1) provides an overview of the power line components to be constructed:

Table 1: Summary of the different components associated with the proposed power line.

Project Component	Specification	Additional Information
Pylon Type	Steel monopoles and/or self-supporting towers	Poles are established in a vertically staggered configuration and are kept upright by stays.
Line Capacity	132 kilovolts	
Pylon Height	23m – 28m on average	
Pylon Separation Distance	200m - 400m	Distance can exceed 500m depending on the topography and terrain to be spanned.
Pylon foundation footprint	10mx10m (100m²)	
Conductor attachment height	25-28 m	
Conductor Type	Tern Conductor	

Project Component	Specification	Additional Information
Corridor assessed in this BA Report	300m	
Servitude	31m	
Minimal Distances (a) Vertical Distance of structures not forming part of the power line (b) Vertical distance of conductors to the ground (c) Distance between trees and shrubs and the bare phase conductor (d) Minimal clearance to other overhead line conductors (e) Above roads and in towns, proclaimed roads	 >3.8m >6.3m >3.8m >2m >7.5m	High voltage power lines require a large clearance area for safety precautions. The Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) provides for statutory clearances.
Access Road	4m wide unsurfaced access road	As far as possible, existing tar and gravel roads will be used to gain access to the site during the construction and operational phase (maintenance purposes) of the project. A new 4m wide unsurfaced road will be established in areas where there are no existing roads.

The new proposed 132kV Power Line (±36 km) will connect the soon to be constructed Olifantshoek Substation near the town of Olifantshoek to the existing Emil Switching Station.

Towers associated with the power line are expected to be an average height of 16m – 20m. The pylons are expected to be steel monopole structures.

The construction of the proposed 132kV overhead power line is likely to follow the following sequence:

- Excavation and concrete work for tower foundations. Due to the dispersed nature of the foundations, it is unlikely for concrete to be batched on site. It is likely that concrete will be ready-mixed and brought in by concrete trucks as and when required.
- Erection of towers in a progressive manner. It is common for materials for several poles to be delivered to the site at the same time. Erection requires the use of a mobile crane to hold prefabricated elements in position. This process is relatively rapid as each pole/pylon is prefabricated off-site.
- Stringing of cables which also requires the use of cranes and mobile hoists to enable workers to fix insulators and attachments and to pull cables between towers.

The above process is relatively clean, rapid, and only affects the area immediately surrounding each tower location as well as the 8m strip along the power line centre line to be cleared (during stringing).

An operating servitude of 31 meters will have to be registered in favour of Eskom to protect the alignment. The servitude provides Eskom with a 'right of way' and will prevent development and any other use that could compromise the overhead line. It will not prevent current agricultural uses or access beneath the line.

The following typical dimensions are likely to apply to the project;

- Tower Height: 16-20m subject to tower selection.
- Tower spacing: 200m – 400m subject to terrain.
- Operating servitude: 31m (15.1m x 2)

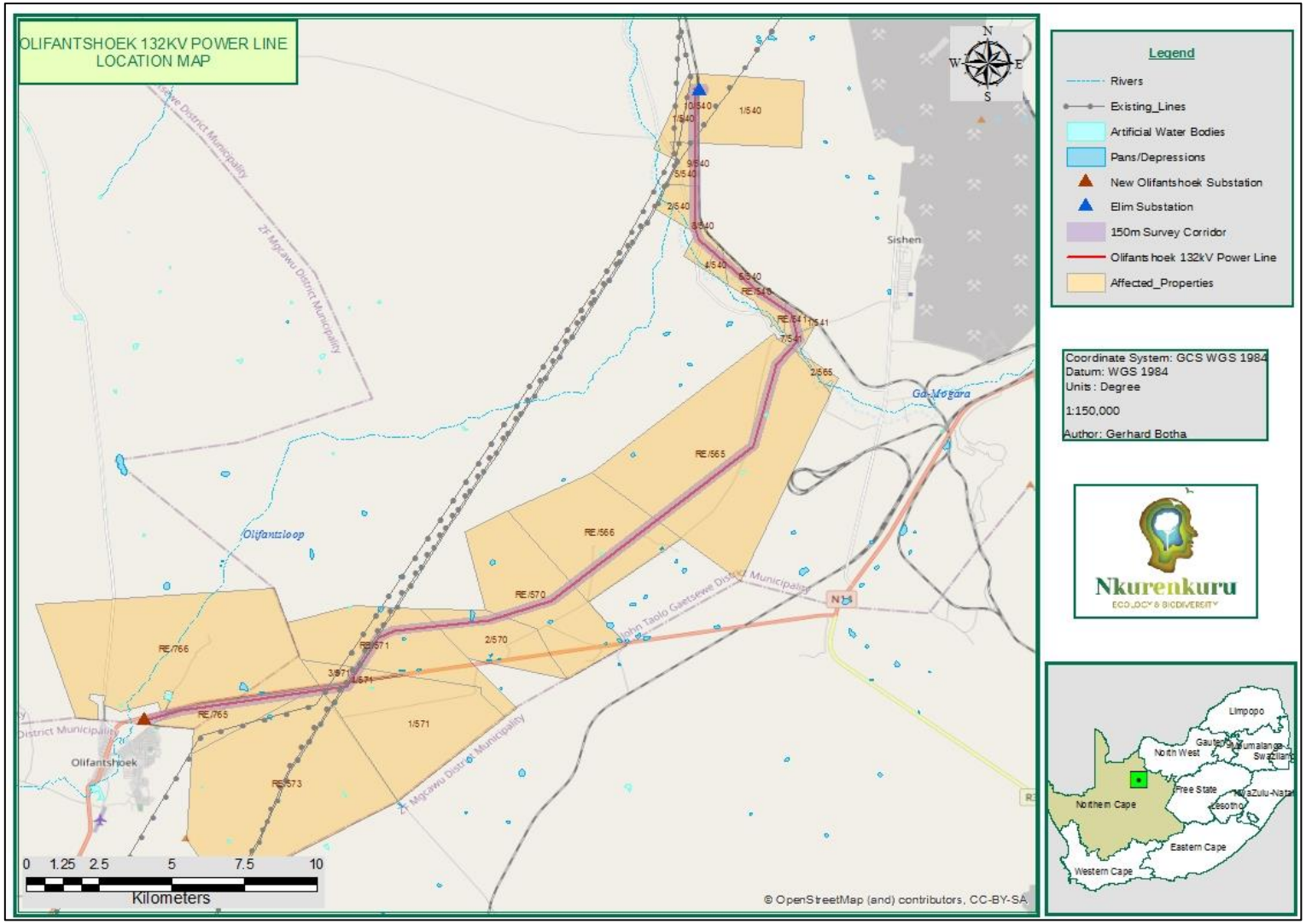

Figure 1: Location map of the proposed Olifantshoek 132kV Power Line.

Terms of reference

The main objectives of this avifaunal study were to:

» Describe the avifaunal associations within the proposed corridor according to species composition,
» Provide an inventory of bird species occurring in the project area including species prone, towards collision and electrocution,
» Provide an impact assessment; and
» Provide an indication of the occurrence of species of conservation concern (threatened, endangered and protected species (according to IUCN, 2017; Taylor et al., 2015; Marnewick *et al.,* 2015).

An avifaunal assessment is required as part of the basic assessment (BA) process to investigate the impacts of the proposed power line on the avian attributes at the study site and its immediate surroundings. The avifaunal attributes along the proposed route will be determined by means of a desktop analysis of GIS based information, third party datasets and a site survey.

The terms of reference are to:

» Conduct a baseline avifauna assessment based on available information pertinent to the ecological and avifaunal attributes on the study site and avifaunal habitat units;
» Conduct an assessment of all information on a BA level in order to present the following results:
    - Typify the regional and site-specific avifaunal macro-habitat parameters that will be affected by the proposed project;
    - Provide a shortlist of bird species present as well as highlighting dominant species and compositions;
    - Provide an indication on the occurrence of threatened, near threatened, endemic and conservation important bird species likely to be affected by the proposed project;
    - Provide an indication of sensitive areas or bird habitat types corresponding to the site;
    - Highlight areas of concern or No-Go areas;
    - Identify and describe impacts that are considered pertinent to the proposed development; and
    - Highlight gaps of information in terms of the avifaunal environment.

Conditions of this report

Findings, recommendations, and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written

consent of the author. Any recommendations, statements, or conclusions drawn from or based on this report must clearly cite or refer to this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.

Relevant legislation

The Convention on Biological Diversity:

The Convention on Biological Diversity (CBD) is an international convention (to which South Africa is a signatory) and represents a commitment to sustainable development. The Convention has three main objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources (http://cbd.int/convention/guide/). Although the convention does not include specific recommendations or guidelines pertaining to birds and energy infrastructure interactions and impacts, it does make provisions for keeping and restoring biodiversity.

The Convention on the Conservation of Migratory Species of Wild Animals:

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) is an intergovernmental treaty and is the most appropriate instrument to deal with the conservation of terrestrial, aquatic and avian migratory species. he convention includes policy and guidelines with regards to the impact associated with man-made infrastructure. CMS requires that parties (South Africa is a signatory) take measures to avoid migratory species from becoming endangered (Art II, par. 1 and 2) and to make every effort to prevent the adverse effects of activities and obstacles that seriously impede or prevent the migration of migratory species i.e. power lines (Art 111, par. 4b and 4c).

The Agreement on the Convention of African-Eurasian Migratory Water Birds:

The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory water birds and their habitat across Africa, Europe, the Middle East Central Asia, Greenland and the Canadian Archipelago. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle and is a legally binding agreement by all contracting parties (South Africa included) to guarantee the conservation of migratory water birds within their national boundaries through species and habitat protection and the management of human activities.

The National Environmental Management: Biodiversity Act:

The National Environmental Management: Biodiversity Act (No. 10 of 2004, NEMBA) regulations on Threatened and Protected Species (TOPS) provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. The national Act and several sets of provincial conservation legislation provide for among other things, the management and conservation of South Africa's biodiversity; protection of species and ecosystems that necessitate national protection and the sustainable use of indigenous biological resources.

Guidelines to minimise the impacts on birds of Solar Facilities and Associated Infrastructure in South Africa:

The "Guidelines to minimise the impact on birds of Solar Facilities and Associated Infrastructure in South Africa" (Smit, 2012) is perhaps the most important (although not legally binding) document from an avifaunal impact perspective currently applicable to solar development in South Africa. The guidelines are published by BirdLife South Africa (BLSA) and detail the recommended procedure for conducting an avifaunal specialist study as well as list all of the potential impacts of interactions between birds and solar facilities and associated infrastructure. We are aware of changes to the BirdLife South Africa best practice guidelines recently published at the Birds and Renewable Energy Forum in Johannesburg (2015) and although the revised requirements are still a work in progress and have not yet been ratified, they will inform this assessment where applicable.

2. METHODOLOGY

Data Scouring and Review

Data sources from the literature were consulted and used where necessary in the study and include the following:

» Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
» Bird distribution data of the Southern African Bird Atlas Project obtained from the Animal Demography Unit of the University of Cape Town, in order to ascertain species occurrence within the study area (Harrison et al. 1997).
» The Birds in Reserves Project database was used to augment bird counts data (Animal Demographic Unit 2015).

» The conservation status of all bird species occurring within the quarter degree square determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Taylor 2014);
» The Important Bird Areas (IBA) programme according to BirdLife South Africa;
» The conservation status, endemism and biology of all species considered likely to occur within the study area was then determined from Hockey et al. (2005) and Taylor et al. (2015).
» A review of all available published and unpublished literature pertaining to bird interactions with power line infrastructure, summarising the issues involved and the current level of knowledge in the field.
» Similar Avifaunal studies that have been undertaken within the region of the study area where also consulted including the survey done for the Solar Park Integration Project (Van Rooyen, 2013) which included a 400kV transmission line stretching from Upington to the Emil Switching Station as well as numerous 132kV transmission lines.

Data Sources Utilized

» The Southern African Bird Atlas Project 1 (SABAP 1; Harrison et al., 1997) quarter degree squares (QDC) 2722DD and 2722DC as well as the Southern African Bird Atlas Project pentads 2740_2255 (1 card), 2745_2250 (2 cards), 2745_2255 (3 cards), 2750_2245 (1 Card), 2750_2250 (3 Cards), 2750_2255 (3 cards) and 2755_2245 (2 cards) were consulted to determine the bird species likely to occur within the study area and the broader impact zone of the development.
» The conservation status, endemism and biology of all species considered likely to occur within the study area was then determined from Hockey et al. (2005) and Taylor et al. (2015).

Field Sampling and Assessment Methodology

Prior to the site visit a review of all available published and unpublished literature pertaining to bird interactions with plants, substations and power lines was undertaken, summarising the issues involved and the current level of knowledge in the field. Various information sources including data on the local avifauna of the area and previous studies of bird interactions with plants, substations and power lines were examined.

A site visit of the project area was conducted from the 4^{h} to the 6th of April 2020 to determine the *in situ* local avifauna and avian habitats present on site. Walked transects, vehicle transects, and vantage point surveys were conducted in various habitats across the site. During the survey, not only the development footprint area was surveyed, but a broader area was inspected. The site was thoroughly traversed to obtain a first-hand perspective of the proposed project and birdlife and to:

» Quantify aspects of the local avifauna (such as species diversity and abundance);
» Identify important avian features present on site (such as nesting and roosting sites);
» Confirm the presence, abundance, habitat preference and movements of priority species;
» Identify important flyways across the site; and
» Delineate any obvious, highly sensitive, no-go areas to be avoided by the development.

Data collection methods included the following:

» Vehicle drive surveys: Vehicle surveys were predominantly done along the farm dirt roads and twin tracks as well as the service road of the existing overhead power lines.
» Power Line inspection: The existing power lines were surveyed daily for the duration of the survey period for any possible raptors or other avifaunal species utilizing the line and pylons for perching. All nests located within the pylons were identified and monitored for a period of time during sunrise and sunset to determine if the nests are active and which species utilized these nests.
» Walked-transects: Walk-throughs were conducted within the study area including the proposed feasible area (refer to Figure 1). These were done along pre-defined areas as well as along random selected areas.
» Fixed point surveys: During the last day of the survey period areas deemed potentially high in avifaunal species diversity was closely monitored for periods of 2 hours each.

The flowing equipment were utilized during field work.

» Canon EOS 450D Camera,
» Swarovski SLC 10X42 WB Binoculars,
» Roberts VII Multimedia Android Edition for Data Capturing and Bird Identification,
» Sasol's The Larger Illustrated Guide to Birds of Southern Africa (2005), and
» Roberts Bird Guide (2016)

The survey was primarily conducted by means of a Checklist Survey supplemented with some notes on avifaunal movement (especially regarding the larger avifaunal species as well as identified nesting species and activities with the patches of higher tree covering). The surveys normally started just before sunrise and ended just after sunset in order to record all possible bird activities throughout the day.

Using the data collected during the desktop phase as well as during the site visit, avian micro-habitats and sensitive habitats for avifaunal communities were identified and mapped.

Mapping of Avifaunal Macro-Habitats and Other Relevant Ecological Features

Mapping has been done by comparing georeferenced ground survey data to the visual inspection of available Google-Earth Imagery (which is a generalised colour composite image without any actual reflectance data attached to it) and in that way extrapolating survey reference points to the entire study area. Delineations are therefore approximate, and due to the intricate mosaics and often gradual mergers of vegetation units, generalisations had to be made. Mapped units will thus show where a certain avifaunal macro-habitat is predominant.

Sensitivity Analysis and Criteria

The determination of specific ecosystem services and the sensitivity of ecosystem components, both biotic and abiotic, is rather complex and no single overarching criterion will apply to all habitats studied. The main aspects of an ecosystem that need to be incorporated in an avifauna sensitivity analysis, however, include the following:

» Describing the nature and number of avifauna species present, taking into consideration their conservation value as well as the probability of such species to survive or re-establish itself following disturbances, and alterations to their specific habitats, of various magnitudes
» Identifying the habitat features that are 'key ecosystem providers' allowing the survival of local avifauna populations within the area
» Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities (Kremen 2005)
» Assessing key environmental factors that influence the provision of services (Kremen 2005)
» Gaining knowledge about the spatial-temporal scales over which these aspects operate (Kremen 2005).

This implies that in the sensitivity analysis not only aspects that currently prevail on the area should be taken into consideration, but also if there is a possibility of a full restoration of the original environment and its biota, or at least the rehabilitation of ecosystem services resembling the original state after an area has been significantly disturbed.

According to the above, sensitivity classes have been summarised as follows:

» **High Sensitivity:** Areas that are relatively undisturbed or pristine and
  - either very species-rich relative to immediate surroundings,
  - or have a very unique and restricted avifaunal species composition
  - Alternatively, constitute specific habitats or a high niche diversity for avifauna of conservation concern, and where the total extent of such habitats and associated species of conservation concern remaining in southern Africa is limited.

- Excessive disturbance of such habitats may lead to ecosystem destabilisation and/or species loss.
- This would also include areas where the abiotic environment is of such nature that the habitat and its niche-diversity are the main reason for a higher avifauna species diversity and cannot be reconstructed or rehabilitated once physically altered in any way.
    - Note: depending on the species composition and abiotic habitat, High Sensitivity Areas can also be specifically denoted as No-Go Areas.

» **Medium Sensitivity:** Areas where disturbances are at most limited and

- Areas with an avifaunal species diversity representative of its natural state, but not exceptionally high or unique compared to its surroundings
- Areas of which the abiotic or biotic configuration does not constitute a very specific or restricted habitat or very high niche diversity
- Areas that provide ecosystem services needed for the continued functioning of the ecosystem and the continued use thereof (e.g. nesting, breeding or foraging resources).
- Although avifaunal species of conservation concern may occur on the area, these are not restricted to these habitats only.
- Areas that need to remain intact to ensure the functioning of adjacent ecosystems, or avifaunal corridors or portions of land that prevent the excessive fragmentation of natural avifauna populations, or areas that will be difficult or impossible to rehabilitate to a functional state after physical alteration
- where the landscape can be rehabilitated to allow the re-establishment of some of the original species composition after physical alteration, but some of the species of conservation concern or ecosystem functionality may be lost

» **Low Sensitivity:** Areas that have been previously transformed, disturbed or

- Areas that provide limited ecosystem services, or have a low ecological value.
- Species diversity may be low or all species present have a much wider distribution beyond this habitat or locality.
- Species of conservation concern may be present on such areas, but these are not restricted to these habitats and can be relocated with ease.
- Further arguments may include landscapes where the abiotic nature is such that it can be rehabilitated relatively easy to allow the re-establishment of the original species composition, and where the development will not lead to any unjustified degradation of landscapes or ecosystem services if adequately mitigated.

Assessment of Impacts

The Environmental Impact Assessment methodology assists in the evaluation of the overall effect of a proposed activity on the environment. This includes an assessment of the

significant direct, indirect, and cumulative impacts. The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

» The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.

» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional,

Immediate area	1
Whole site (entire surface right)	2
Neighboring areas	3
Regional	4
Global (Impact beyond provincial boundary and even beyond SA boundary)	5

» The **duration**, wherein it was indicated whether:

Lifetime of the impact will be of a very short duration (0 – 1 year)	1
The lifetime of the impact will be of a short duration (2 – 5 years)	2
Medium-term (5 -15 years)	3
Long term (> 15 years)	4
Permanent	5

» The **magnitude**, quantified on a scale from 0 – 10,

small and will have no effect on the environment	2
minor and will not result in an impact on processes	4
moderate and will result in processes continuing but in a modified way	6
high (processes are altered to the extent that they temporarily cease)	8
very high and results in complete destruction of patterns and permanent cessation of processes	10

» The **probability** of occurrence, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1 -5,

very improbable (probably will not happen)	1
improbable (some possibility, but low likelihood)	2
probable (distinct possibility)	3
highly probable (most likely)	4
definite (impact will occur regardless of any prevention measures)	5

» The **significance**, was determined through a synthesis of the characteristics described above and can be assessed as;
- **LOW**,
- **MEDIUM** or
- **HIGH**;

» the **status**, which was described as either positive, negative or neutral.
» the degree of which the impact can be reversed,

» the degree to which the impact may cause irreplaceable loss of resources,
» the degree to which the impact can be mitigated.

The significance was calculated by combining the criteria in the following formula:

S=(E+D+M)P where;

» S = Significance weighting
» E = Extent
» D = Duration
» M = Magnitude
» P = Probability

The significance weightings for each potential impact are as follows;

Table 2: Rating table used to rate level of significance.

RATING	CLASS	MANAGEMENT DESCRIPTION
< 30	**Low (L)**	Where the impact would not have a direct influence on the decision to develop the area.
30 - 60	**Medium (M)**	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> High	**High (H)**	Where the impact must have an influence on the decision process to develop in the area.

Assumptions and Limitations

General Assumptions and Limitations

» This report deals exclusively within a defined area (300m survey area/corridor) and the impacts upon avifaunal biodiversity and avifaunal macro-habitats in that corridor area and immediate surrounding landscape
» All relevant project information provided by the applicant and engineering design team to the specialist was correct and valid at the time that it was provided.
» Additional information used to inform the assessment was limited to data and GIS coverage's available for the Northern Cape Province at the time of the assessment.
» It is assumed that third party information (obtained from government, academic/research institution, non-government organisations) is accurate and true.
» Some datasets may be out of date and therefore extant distribution ranges may have shifted although these datasets provide insight into historical distribution ranges of relevant species.
» Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit of the University of Cape Town were relatively recently initiated and therefore data from these sources are still limited/incomplete.

Sampling Limitations and Assumptions

» While disturbance and transformation of habitats can lead to shifts in the type and extent of ecosystems, it is important to note that the current extent and classification are reported on here.
» Sampling by its nature means that generally not all aspects of ecosystems can be assessed and identified.
» The timing of the survey was commissioned literally a week after the area received its first major burst of precipitation, following a severe drought period. This means that the vegetation has not fully recovered from the pending dry period.
» Probably the most significant potential limitation associated with such a sampling approach is the narrow temporal window of sampling.
  - Ideally, a site should be visited several times, during different seasons to ensure that the full complement of avifaunal species present is captured.
  - However, this is rarely possible due to time and cost constraints and therefore, the representation of the species sampled at the time of the site visit should be critically evaluated.
  - The footprint was covered in detail with the result that the results are considered highly reliable and it is unlikely that there are any significant species or features present that were not recorded.

3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term 'Biodiversity' is used to describe the wide variety of plant and animal species occurring in their natural environment or 'habitat'. Biodiversity encompasses not only all living things but also the series of interactions that sustain them, which are termed 'ecological processes. South Africa's biodiversity provides an important basis for economic growth and development; and keeping our biodiversity intact is vital for ensuring the on-going provision of ecosystem services, such as the production of clean water through good catchment management. The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (Driver *et al.,* 2012). Typical pressures that natural ecosystems face from human activities include the loss and degradation of natural habitat, invasive alien species, pollution, and waste and climate change (Driver *et al*.,2012). High levels of infrastructural and agricultural development typically restrict the connectivity of natural ecosystems, and maintaining connectivity is considered critical for the long-term persistence of both ecosystems and species, in the face of human development and global climatic change. Loss of biodiversity puts aspects of our economy and quality of life at risk and reduces socioeconomic options for future generations as well. In essence, then, sustainable development is not possible without it.

4. STUDY AREA

Regional/Local Biophysical Setting

The project is located in the Olifantshoek region, which falls within the Gamagara Local Municipality and the John Taolo Gaetsewe District Municipality. The study area extends from the Olifantshoek Substation (soon to be constructed) in the south and will terminate into the Emil Switching Station in the north. The proposed power line will be approximately 36km in length. The proposed route will, for large sections, run parallel to existing power line infrastructure including a section which will run along the existing Ferrum/Nieuwehoop 400kV and Ferrum/Lewensaar 132kV power lines.

The approximate location (farm properties and geographic coordinates) for the proposed project (power line route including the 300m survey corridor) are as follows:

Proposed connection point to Emil Switching Station

- Farm Property:
  - Portion 1 of the Farm Fritz 540
- Geographical Coordinates
  - -27.736365; 22.920617

Proposed connection point to Olifantshoek Switching Station

- Farm Property:
  - Portion 1 of the Farm Neylan 574
- Geographical Coordinates
  - -27.931425°; 22.748489°

Affected Farm Properties (Refer to Figure 1)

- Remaining Extent of the Farm Fritz 540
- Portion 1 of the Farm Fritz 540
- Portion 2 of the Farm Fritz 540
- Portion 4 of the Farm Fritz 540
- Portion 5 of the Farm Fritz 540
- Portion 8 of the Farm Fritz 540
- Portion 9 of the Farm Fritz 540
- Portion 10 of the Farm Fritz 540
- Remaining Extent of the Farm Gamagara 541
- Portion 1 of the Farm Gamagara 541
- Portion 7 of the Farm Gamagara 541

- Portion 1 of the Farm Wright 538
- Remaining Extent of the Farm Dingle 565
- Portion 2 of the Farm Dingle 565
- Remaining Extent of the Farm Smythe 566
- Remaining Extent of the Farm Murray 570
- Portion 2 of the Farm Murray 570
- Remaining Extent of the Farm Cox 571
- Portion 1 of the Farm Cox 571
- Portion 3 of the Farm Cox 571
- Portion 4 of the Farm Cox 571
- Remaining Extent of the Farm Hartley 573
- Portion 3 of the Farm Hartley 573
- Remaining Extent of the Farm Diegaart's Heuwel 765
- Remaining Extent of the Farm Neylan 574
- Portion 1 of the Farm Neylan 574
- Remaining Extent of the Farm Neylan 766
- Portion 3 of the Farm Neylan 766
- Portion 4 of the Farm Neylan 766
- Portion 7 of the Farm Neylan 766
- Remaining Extent of Erf 155 Olifantshoek

Land use within the project site is mostly for farming. Farming practices consist mainly of cattle and game farming. The northern section of the power line route will traverse historically cultivated areas (indications of pivots), however, recruitment of indigenous vegetation has substantially occurred, and succession is in a relatively advanced state. Major land transformation within the survey corridor is due to numerous roads, railway, cleared servitudes for power lines as well as some small-scale mining and borrow pits.

The closest built-up area is the town of Olifantshoek (Figure 1) situated just south of the Olifantshoek Substation.

The affected landscape is drained by the Olifantsloop River and the Ga-Mogara River. The Olifantsloop River is a relatively short river flowing in a north to north-east direction, terminating into the Ga-Mogara River. The Ga-Mogara River is the most prominent drainage feature within the Quaternary Catchment and feeds into the Kuruman River to the North-East. Both rivers are ephemeral. The proposed route will cross the Ga-Mogara River within its middle reach, west of the Sishen Iron Ore Mine.

A summary of the biophysical features and the setting of the project site and surroundings are summarised in Table 3 below (also refer to Appendix 6 for a more detailed description of the biophysical setting).

Table 3: Summary of the biophysical setting of the projects site as well as the surroundings

Biophysical Aspect	Desktop Biophysical Details		Source
Physiography			
Av. Elevation a.m.s.l	1207m		Google Earth & ArcGis
Max. Elevation a.m.s.l	1287m		Google Earth & ArcGis
Min. Elevation a.m.s.l	1158m		Google Earth & ArcGis
Av. slope	1.1%; -1.0%		Google Earth & ArcGis
Maximum slope	6.8%; -4.8%		Google Earth & ArcGis
Landscape Description	Undulating plain covered by aeolian (regic) red sand. Typographical variations due to low hills, ridges, areas where thinning of the sand have exposed calcrete, chert and lava surfaces, and the Ga-Mogara River. Small depression wetlands/" Pans" are also a prominent feature of the landscape, although only three such features are located within the surveyed corridor. The most prominent geographical features within the area are the Langeberg Mountain range to the west and the Ga-Mogara River. The most prominent anthropogenic features within the area are the town of Olifantshoek and the Sishen Iron Ore Mine.		Google Earth & Mucina and Rutherford, 2006
Climate			
Mean annual temperature	18.6°C		Climate-data.org
Warmest Month & Av. Temp.	January: 25.3°C		Climate-data.org
Coldest Month & Av. Temp.	July: 10.8°C		Climate-data.org
Rainfall Seasonality	Late Summer (Highest in March)		DWAF, 2007
Mean annual precipitation	395 mm		Schulze, 1997
Mean annual runoff	2.9 mm		Schulze, 1997
Mean annual evaporation	2200-2600 mm		Schulze, 1997
Surface Hydrology			
Main collecting river(s) in the catchment	Quaternary catchment	Sub quaternary catchment	CSIR, 2011
	Olifants and Ga-Mogara	Kuruman	
Closest river to the project site	Ga-Mogara		Google Earth
Length of river	±88.037 km		CSIR, 2011
Distance (nearest point from development site)	The proposed power line will cross a section of the river. GPS Point: -27.815458°; 22.949310°		Google Earth
Vegetation Overview			
Biome	Savanna Biome (Eastern Kalahari Bushveld Bioregion)		Mucina & Rutherford, 2011
Vegetation Types (Figure 4)	Kuruman Thornveld (SVk 9), Kathu Bushveld (SVk 12) & Olifantshoek Plains Thornveld (SVk 13)		Mucina & Rutherford, 2011
Vegetation & Landscape Feature	Olifantshoek Plains Thornveld: A very wide and diverse unit on plains with usually open tree and shrub layers with, for example, *Vachellia luederitzii, Boscia albitrunca,* and *Searsia tenuinervis* and wit a usually sparse grass layer. Kathu Bushveld: Medium-tall tree layer with *Vachellia erioloba* in places, but mostly open and including most important shrubs such as *Senegalia mellifera*, *Diospyros lycioides, Lycium hirsutum*. The grass layer is variable in cover. Kuruman Thronveld: Flat rocky plains and some sloping hills with very well-developed, closed shrub layer and well-developed open tree stratum consisting of *Vachellia erioloba*.		Mucina & Rutherford, 2006

Climate and Rainfall

The Olifantshoek/Kathu area is characterized by an arid summer rainfall climate with an average annual temperature of 18.6°C and an average rainfall of 395mm falling predominantly in late summer (highest in March: 74mm). The driest month is July with only 3mm of precipitation. With an average temperature of 25.3°C, January is the warmest month, whilst July is the coldest month with an average of 10.8°C (https://en.climate-data.org/location/27075/).

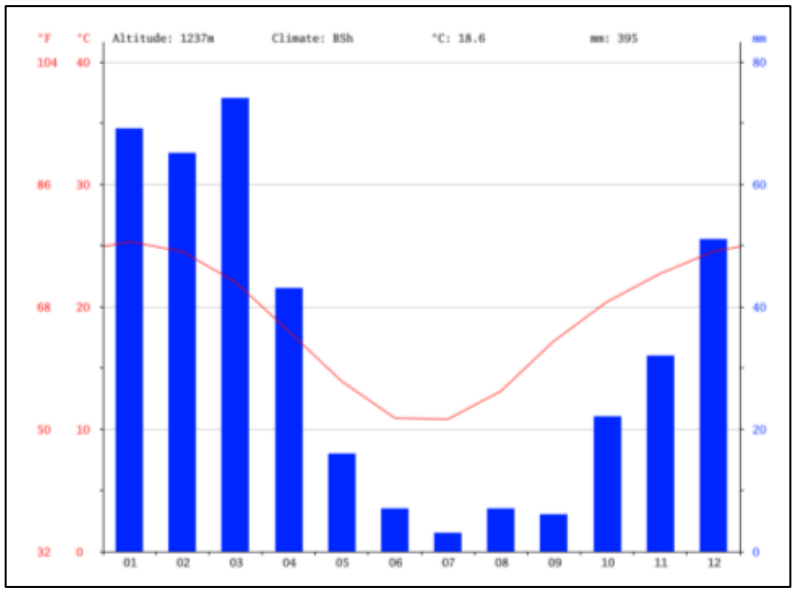

Figure 2: Climate graph of Olifantshoek/Kathu region (https://en.climate-data.org/location/27075/).

month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Okt	Nov	Dec
mm	69	65	74	43	16	7	3	7	6	22	32	51
°C	25.3	24.5	22.0	18.0	13.9	10.9	10.8	13.1	17.2	20.4	22.7	24.5
°C (min)	18.0	17.4	15.2	10.5	5.8	2.4	2.1	4.2	8.4	12.1	14.8	16.9
°C (max)	32.6	31.6	28.9	25.6	22.1	19.5	19.5	22.0	26.0	28.7	30.7	32.2
°F	77.5	76.1	71.6	64.4	57.0	51.6	51.4	55.6	63.0	68.7	72.9	76.1
°F (min)	64.4	63.3	59.4	50.9	42.4	36.3	35.8	39.6	47.1	53.8	58.6	62.4
°F (max)	90.7	88.9	84.0	78.1	71.8	67.1	67.1	71.6	78.8	83.7	87.3	90.0

Figure 3: Climate table of Olifantshoek/Kathu region (https://en.climate-data.org/location/27075/).

Existing Land Use

Land use within the study area is mostly for farming. Farming practices consist mainly of cattle and game farming and to a lesser extent farming with sheep and goats. North of the N14 the power line will traverse, for approximately 4km, degraded land, mainly due to

grazing pressure from cattle and game and the gravel pit located just north of the N14. Historically some areas have been ploughed and irrigated, mainly for the cultivation of lucern, ranging in size between 2ha to 16ha on some farms that had high yielding boreholes. The northern portion of the proposed power line will traverse such a historically cultivated area. Apart from agricultural practices, mining forms the largest industrial land use activity within the larger landscape (e.g. Sishen Iron Ore Mine is located to the west of the study area).

The proposed power line will be, for a short distance, located parallel to the existing servitude of the 275kV power line and new 400kV power line. The servitudes of the 275kV & 400kV power lines have been cleared of all tall trees and shrub species. The power line will cross the gravel road to Dingleton in the north after which it will connect to the existing Emil Switching Station.

Major land transformation within the survey corridor is due to numerous roads, railway, cleared servitudes for power lines as well as some small-scale mining and borrow pits.

Vegetation Overview

The study area falls within the Eastern Kalahari Bushveld Bioregion (Savannah biome). Several vegetation types characterise the larger area (Mucina & Rutherford, 2006) although the footprint of the proposed development traverses only three vegetation types namely:

- Olifantshoek Plains Thornveld (SVk13) – the bulk of the footprint falls within this vegetation type.
- Kathu Bushveld (SVk12) – Only the northernmost portion of the footprint falls within this vegetation type.
- Kuruman Thornveld (SVk 10)

Olifantshoek Plains Thornveld mostly occupies plains including most of the pediment areas of the Korannaberg, Langeberg and Asbestos Mountains as well as those of some ridges to the west of the Langeberg. This vegetation type overlies mostly red aeolian sand with silcrete and calcrete and some andesitic and basaltic lava of Griqualand West Supergroup. Hutton soil form forms the dominant soil form. This is a very wide and diverse unit characterised mostly by open tree and shrub layers with, for example, *Vachellia luederitzii, Boscia albitrunca* and *Searsia tenuinervis* and with a usually sparse grass layer (Mucina & Rutherford, 2006).

Kathu Bushveld covers the plains around Kathu and Dibeng in the south, through Hotazel, vicinity of Frylinckspan to the Botswana border roughly between Van Zylsrus and McCarthysrus. This vegetation type overlies mostly aeolian red sand with some surface calcrete present in localised areas. Deep sandy soils of Hutton and Clovelly soil forms

characterise most of the area. These sandy plains are covered mostly by an open medium tree layer with *Boscia albitrunca* as the prominent tree, although in some places a medium-tall tree layer, with *Vachellia erioloba*, may become dominant. Shrubs layer generally most important with, for example *Senegalia mellifera, Diospyros lycioides*, and *Lycium hirsutum*. Grass layer is variable in cover (Mucina & Rutherford, 2006).

Kuruman Thornveld vegetation unit occupies an area of about 5794km^2 and extends from around Postmasburg and Danielskuil (flats, west of the Kuruman Hills) in the south via Kuruman to Tsineng and Dewar in the North. This vegetation type occupies flat rocky plains and some sloping hills characterised by dolomites and chert of the Campbell Group as well as younger, superficial Kalahari Group sediments with red wind-blown (0.3-1.2 m deep) sand. These rocky plains and sloping hills is covered by a very well-developed, closed shrub layer and well-developed open tree stratum consisting of *Vachellia erioloba* (Mucina & Rutherford, 2006).

All three of the above described vegetation types are regarded as least threatened.

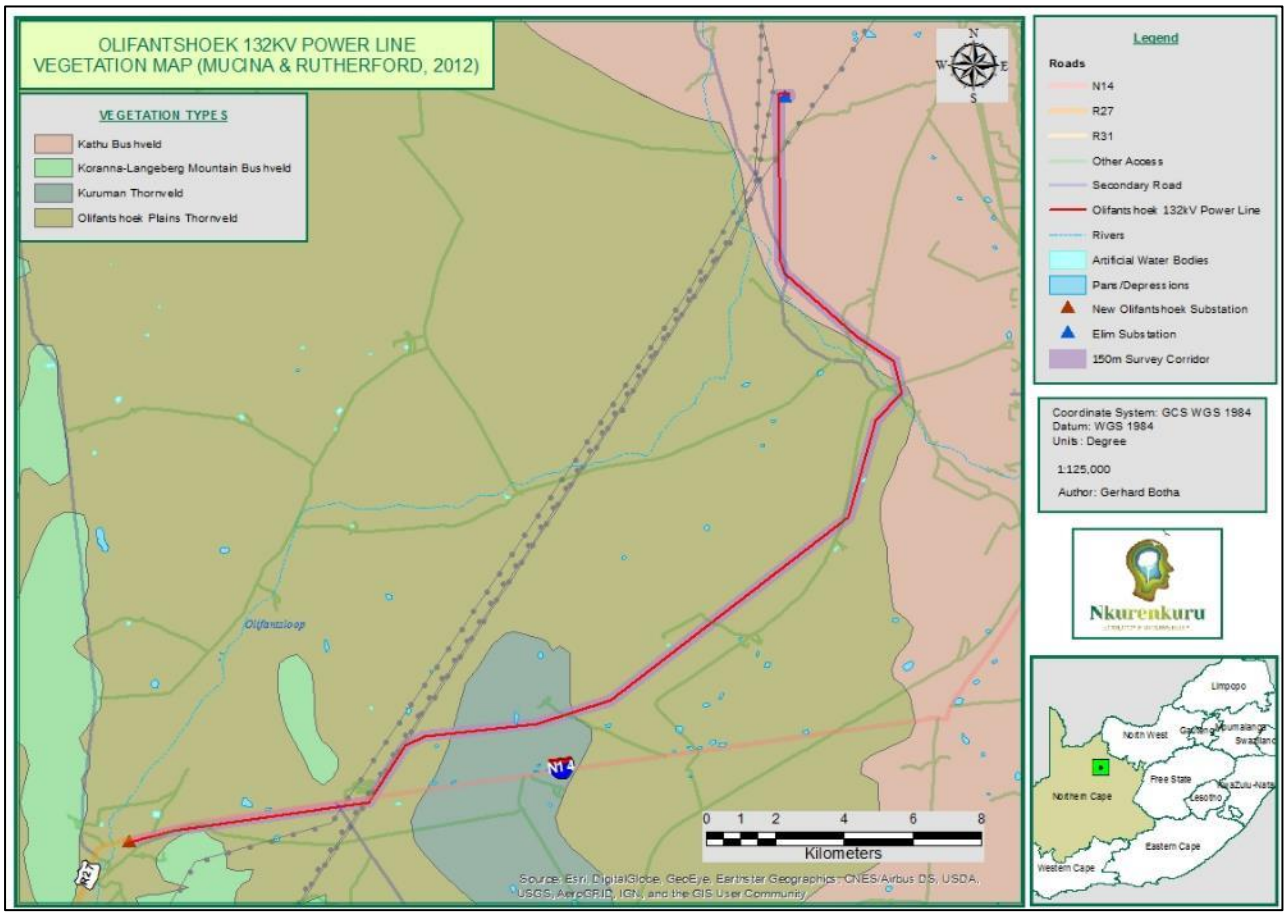

Figure 4: Broad-scale overview of the major vegetation units (according to Mucina and Rutherford, 2012) found within and around the study site (survey corridor).

Topography and Drainage

The landscape can be described as a gently undulating plain interrupted by rocky outcrops and low hills in the south and exposed calcrete and chert plains to the north-east. The landscape has a general south-west to a north-east slope, from the Langeberg Mountains to the west, towards the Ga-Mogara River valley. The Langeberg Mountain range and the Ga-Mogara River are the most important and prominent geographical features.

The southern portion (6km), south of the N14, is located within an undulating landscape comprising of moderate to deep sandy valleys and foot slopes intersected by low hills and rocky outcrops.

The section of the power line route between the N14 Road and the Ga-Mogara River can be described as a gently undulating plain with slight typographical variations within the landscape as a result of the varying depth of the aeolian regic sands. Low lying areas are associated with the deposited sands that have been thinned out, exposing chert, volcanic rock, and calcrete surfaces, as well as the lower-lying ephemeral Ga-Mogara River which can be characterised as a relative shallow alluvial valley with moderate sloping banks.

North of the Ga-Mogara River, the landscape becomes much flatter with less typographical variation and is dominated by a relatively deep regic sand cover.

The entire study area is drained by these main, non-perennial watercourses namely the Olifantsloop River (42.492 km) and the Ga-Mogara River (88.037 km). The Olifantsloop River originates within Langeberg Mountain range, west of the town of Olifantshoek. The watercourse flows in an eastern direction until reaching Olifantshoek, after which it flows in a north-eastern direction to terminate into the Ga-Mogara River (~1.1 km south-east of the point where the proposed powerline will cross the Ga-Mogara River). The Ga-Mogara River originates as smaller tributaries within the Asbestos Mountains north-east of the town of Danielskuil and flows in a north-western direction past smaller settlements as well as the southern portion of the Sishen mining area (Dingelton). The entire system is endorheic with the Ga-Mogara River flowing into the Kuruman River close to Hotazel, after which the Kuruman River flows into the Molopo River at Andriesvale south of the Kgalagadi Transfontier Park. From there, the Molopo flows into the Abiekswasputs pans north of the town of Noenieput. There is hence no outflow into the sea.

The only natural wetlands in the project area are small, endorheic, closed depressions/pans. *A depression is a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates. Dominant water sources are precipitation, groundwater discharge, interflow, and (diffuse or concentrated) overland flow. Dominant hydrodynamics are (primarily seasonal) vertical fluctuations. Pans such as in the study area are flat-bottomed*

lack in and outlets. For this 'endorheic depression', water exits by means of evaporation and infiltration

These depressions form due to micro-topography variations of the underlying substrates (shallower soils over calcrete), giving rise to low grasslands on pan bottoms (may even be devoid of vegetation). The outer belt of these pans comprises of a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with a fairly high content of Calcium and Phosphate. The pan soils consist of white (washed) sand and is exposed for most of the year and carry shallow pools for a short period of time following sufficient rains.

Conservation Areas, Protected Areas and Important Bird Areas

There are no formal or informal protected areas or any Important Bird and Biodiversity Areas in close proximity to the site. The nearest Important Bird Areas (IBAs) to the study site are Spitskop Dam (SA028), and Dronfield (SA031) located approximately 155km away to the east and 201km away to the south-east.

5. RESULTS AND DISCUSSION

Avian Micro-Habitats

Most of the abundance and distribution of avian species can usually be attributed to the vegetation types and bioregions within an area. In determining the suitability of the study area for avian species, it is necessary to look at the habitats available to determine where the relevant species will most likely occur within the study area. These "micro habitats" do not always correspond to vegetation types and are determined by a combination of vegetation type, topography, land use, food sources and other various intrinsic factors.

Investigation of the study area revealed the following important avian micro-habitats.

- Open Tree Savanna
- Shrubland Savanna
- Ridges and outcrops
- Non-perennial watercourses
- Small depression wetlands
- Artificial landscapes including:
  a) Cleared servitude underneath the 275kV and 400kV power lines
  b) The 275kV and 400kV power lines

c) Olifantshoek sewage works

The Open Tree Savanna

These savannas occupy deep, red, sandy to sandy-loam soils found within the southern and northern portions of the project site and comprise of an open, medium-tall woody component (*Vachellia erioloba, Vachellia tortilis,* and *Ziziphus mucronata*). Small trees and shrubs are also co-dominant characterised by *Trachonanthus camphoratus, Senegalia mellifera, Grewia flava,* and *Boscia albitrunca*. The herb layer has been significantly impacted by the drought of the previous years and is relatively sparse and dominated by a relatively high diversity of forbs as well as *Stipagorstis uniplumis*. The density of the grass cover can also be related to grazing intensity with grass cover decreasing as grazing intensity increases. Key/diagnostic species of the herbaceous layer includes *Senna italica, Tribulus terrestris, Tallinum caffrum, T. crispatulum, Melhania prostrata, Pentzia incana, P. calcarea, Kyphocarpa angustifolia, Indigofera daleoides, I. holubii, Justicia divaricate, Gnidia capitate, Kohautia caespitose, Oxygonum delagoense, Eragrostis lehmanniana, Tragus racemosus, Aristida congesta* and *Eragrostis echinochloidea*.

Variations in terms of species composition, structure and grass-tree and tree-shrub interactions persist throughout this habitat type. Probably the most significant variation of this habitat is the patches of tall woodlands comprising of *V. erioloba, V. karroo and Z. mucronata*. These tall woodlands occur in deep soil pockets interbedded especially within the shrubland savanna contributing to habitat and niche diversity within these areas. These tall woodlands are regarded as important habitat for avifaunal species serving as nesting, perching and shelter for various species. Smaller granivorous birds constantly move between the outer edge of these woodlands and the open shrublands (Blue waxbill – *Uraeginthus angolensis*, Violet-eared Waxbill – *Uraeginthus granatinus*, Black-throated Canary – *Crithagra atrogularis* and Cape Bunting – *Emberza capensis*). Frugivorous birds such also frequent this habitat type, especially the larger fruit bearing *Z. mucronata* specimens (Acacia Pied Barbet – *Tricholaema leucomelas*, White-backed Mousebird – *Colius colius*).

Also a noteworthy form of this tree savanna is the tree savanna to the far north of the study site where most of the larger *V. erioloba* species have been removed to accommodate for agricultural practices (pivot) although numerous species have started to re-establish. The flowering forbs (especially *Tribulus terrestris*) within this area attracted numerous insects and the area was teeming with insectivorous birds (Swallow-tailed Bee-eater – *Merops hirundineus*, European Bee-eater – *Merops apiaster*, Fork-tailed Drongo – *Dicrurus adsimilis*, Black-chested Prinia - *Prinia flavicans*, Chestnut-vented Tid-Babbler – *Sylvia subcaerulea*, Marico Flycatcher - *Bradornis mariquensis* and Spotted Flycatcher – *Muscicapa striata*)

This habitat provides a niche for a relatively high diversity (when compared to the other habitats) of avifaunal species and includes ground-dwelling species such as Helmeted Guineafowl (*Numida meleagris*), Red-billed Spurfowl (*Pternistis adspersus*), Northern Black Korhaan (*Afrotis afraoides*), Red-crested Korhaan (*Lophotis ruficrista*) as well as the two Sandgrouse species found in the region (Namaqua Sandgrouse – *Pterocles namaqua* and Burchell's Sandgrouse – *P. burchelli*). This habitat is also well represented by passerine and near passerine birds and includes species such as Chats, Scrub-Robbins various Larks (Family: Alaudidae), Robin-Chats, Thrushes, Warblers, Bee-eaters, Yellow-bellied Eremomelas (*Eremomela ictyropygialis*), Scaly-feathered Weaver (*Philetairus socius*), Black-chested Prinias (*Prinia flavicans*), Pririt Batis (*Batis pririt*), Chestnut-vented Tit-Babbler (*Parisoma subcaeruleum*), Bokmakierie (*Telophorus zeylonus*), Crimson-breasted Shrike (*Laniarius atroccineus*), Sociable Weaver (*Philetairus socius*), African Grey Hornbill (*Lophoceros nasutus*), Fork-tailed Drongo (*Dicrurus adsimilis*), Southern Pied Babbler (*Turdoides bicolor*), Lilac-breasted Roller (*Coracias caudatus*), and Marico Sunbird (*Cinnyris mariquensis*). Raptors found within this woodland included Black-winged Kite (*Elanus caeruleus*), Gabar Goshawk (*Micronisus gabar*), Pygmy Falcon (*Polihierax semitorquatus*) and Greater Kestrel (*Falco rupicoloides*). Other noteworthy species noted included: Namaqua Dove (*Oena capensis*), Ring-neck Dove (*Streptopelia capicola*), Common Cuckoo (*Cuculus canorus*), Golden-tailed Woodpecker (*Compethera abingoni*) and Shaft-tailed Whydah (*Vidua regia*).

Three Red Data species were confirmed within this micro-habitat namely Kori Bustard (*Ardeotis kori*), Martial Eagle (*Polemaetus bellcosus*) and White-backed Vulture (*Gyps africanus*). The Martial Eagle as well as the White-backed Vultures were associated (perching and roosting) with the existing 400kV power line that traversed this habitat type.

Current land use within this habitat includes predominantly stock and game farming.

The potential impacts associated with the mentioned infrastructure within this micro-habitat, include moderate displacement due to habitat loss and disturbance, as well as potential collision with the power line (Bustards, Korhaans and Sandgrouse species).

Figure 5: Open savanna woodland.

Figure 6: Taller and more dense savanna woodland.

Shrubland Savanna

The shrubland savanna occurs on rocky ridges and hills or where the regic sand becomes thinned out exposing rock beds. The type of geology and soil depth determines the composition and structure of this savanna type. Large trees are mostly absent from these areas or are scattered as singular species. The shrub layer is typically between 1.7m and 2.5m. Key shrub species include *Senegalia mellifera, Trachonanthus camphoratus, Grewia flava,* and *Rhigozum tricotomum*. Smaller specimens of *V. erioloba* may also be present, but is more scarcely scattered between the shrubs. The density of this tree/shrub layer varies from relatively dense (almost thicket like) *A. mellifera* dominated woodland to a more open *T. camphoratus* woodland comprising of a moderate to well-developed grass

layer (where not overgrazed). The grass layer is characterised by *Aristida meridionalis, A. adscensionis, A. congesta, Enneapogon spp., Eragrosits lehmanniana, E. chloromelas, E. pallens, Stipagrostis ciliate, S. uniplumis, Tragus racemosa* and *Melinis repens*.

Although avifaunal activity within this unit is lower, with a lower abundance and diversity of avifaunal species, this micro-habitat is utilised, more or less, by the same key species as in the case of the *A. erioloba* woodland. Key species include Northern Black Korhaan (*Afrotis afraoides*), Lark species (Family: Alaudidae); species such as Chats, Thrushes and Scrub-Robbin will move around within the taller shrubby areas. Probably the most abundant species recorded within this habitat was Chestnut-vented Warbler (*Sylvia subcaerulea*), Kalahari Scrub Robin (*Cercotrichas paean*), Sociable Weaver (*Philetairus socius*) and Scaly-feathered Weaver (*Sporopipes squamifrons*) The denser encroached *Acacia mellifera* veld also provide nesting habitat for smaller species such Yellow-bellied Eremomela (*Eremomela ictyropygialis*), Black-chested Prinia (*Prinia flavicans*), Rufous-eared Warbler (*Malcorus pectoralis*) and also the Pririt Batis (*Batis pririt*).

Current land use within this habitat includes predominantly stock and game farming. As mentioned, some portions of land have been somewhat encroached by *Acacia mellifera* impacting the grazing potential of the land.

The impacts associated with the development within this micro-habitat are displacement, due to habitat loss and disturbance, as well as collision with the power line (Bustards, Korhaans and Sandgrouse species).

Figure 7: *Open savanna shrubland*

Figure 8: Savanna shrubland dominated by *Trachonanthus camphoratus*. Note the transmission infrastructure in the background.

Figure 9: Dense, almost closed *Senegalia mellifera* savanna shrubland

Ridges and Outcrops

This unit occupies the outcrops (mostly andesitic lava and chert outcrops) located south of the N14. This unit is characterised by an open shrubland, with *Senegalia mellifera* being the dominant shrub species. Dwarf shrubs and succulents are also well represented within this vegetation unit. Key species include; *A. mellifera, Grewia flava, Ehretia rigida, Searsia tridactyla, Euclea undulata, Asparagus laricinus, Rhigozum tricotomum, Aloe hereroensis,*

A. grandidentata, Euphorbia mauritanica, Hermannia erodioides, H. tomentosa, Sida spp., Gisekia spp., Stipagrostis uniplumis, Eragrostis nindensis, and *Stipagrostis obtusa*.

This micro-habitat is utilised primarily by the same passerine species utilising the shrubland savanna habitat namely Lark species (Family: Alaudidae) Chats, Thrushes and Scrub-Robbins. *Acacia mellifera* may encroach some areas forming denser patches, providing nesting habitat for smaller species such Yellow-bellied Eremomela (*Eremomela ictyropygialis*), Black-chested Prinia (*Prinia flavicans*), Rufous-eared Warbler (*Malcorus pectoralis*) and possibly also Pririt Batis (*Batis pririt*)

Current land use within this habitat includes predominantly stock farming.

The impacts associated with the development within this micro-habitat are displacement due to habitat loss and disturbance, as well as potential collision with the power line.

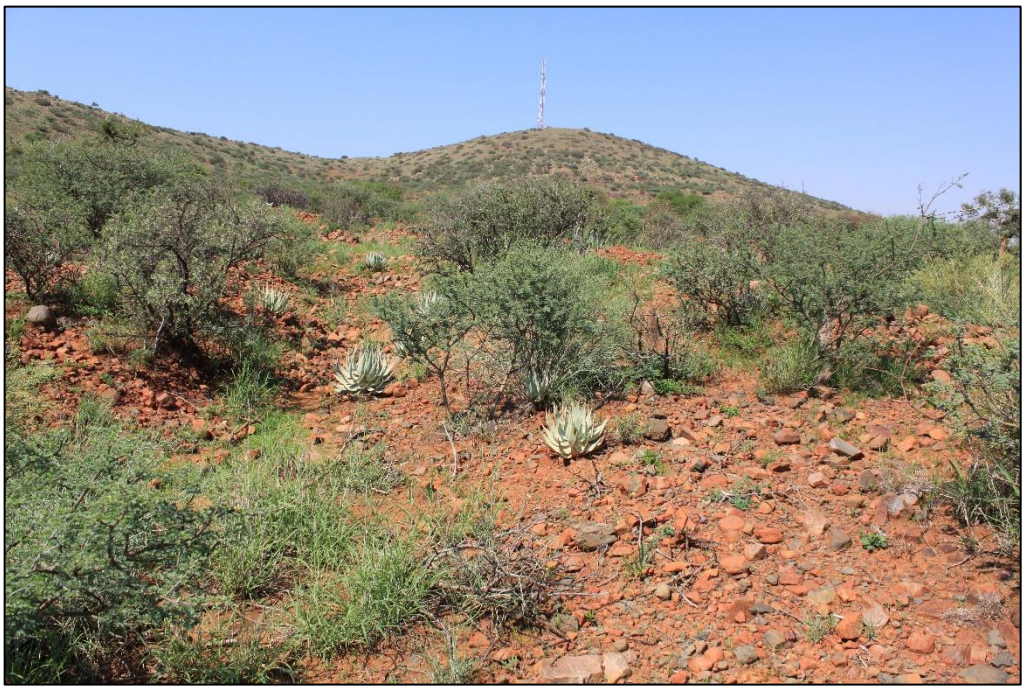

Figure 10: Ridge covered by an open savanna shrubland.

Non-perennial Watercourses

The power line will cross the ephemeral Ga-Mogara River (-27.815458°; 22.949310°). The Ga-Mogara River is the most prominent hydrological feature within the region. The reach section surveyed was comprised of a relatively well-defined river channel and bank.

The channel bed comprises predominantly of moisture loving graminoids and forbs. A small lower lying section of this channel is typically inundated seasonally for very short periods

of time following sufficient rain. Key species within this portion of the channel are: *Juncus rigidus, Cyperus longus* var. *tenuiflorus* and *Panicum coloratum, Helichrysum aureonitens* and *Stachys spathulata.* The broader marginal zone, which is rarely inundated contain graminoid species such as *Cynodon dactylon, Panicum coloratum, Tribulus terrestris, Eragrostis trichophora, Eragrostis echinochloidea, E. truncata, Salvia runcinata,* and *Pentzia calcarea.* Towards the outer edges of the marginal zone shrubs and dwarf shrubs such as *Vachellia hebeclada, Felicia muricata, Selago dinteri,* and *Lycium cinerium* becomes more prominent.

Patches of tall, dense Vachellia woodlands are found along the Ga-Mogara River and comprise of tall trees such as *Vachellia karroo, V. erioloba, and Ziziphus mucronata.* The forb layer is strongly influenced by the nature of the tree canopy. Where the tree canopy is more open, grasses such as *Eragrostis echinocloidea, Enneapogon desvauxii, Eragrostis lehmanniana, Setaria verticillata,* and *Sporobolus fimbriatus* are more prominent. Riparian woodlands with a denser canopy contain an herb layer represented with a higher diversity of forbs such as *Acharanthes aspera, Pupalia lappacea, Pavonia burchelli, Melhania virescens* and *Sida cordifolia* as well as the shrub *Asparagus exuvialis and Asparagus cooperi.*

The grassy channel bed is characterised by avifaunal species such as Eastern Clapper Lark (*Mirafra fasciolata*), Spike-heeled Lark (*Chersomanes albofasciata*), Capped Wheatear (*Oenanthe pileata*), Crowned Lapwing (*Vanellus coronatus*) and African Pipit (*Anthus cinnamoneus*).

The patches of tall riparian woodlands contribute to habitat and niche diversity. These tall woodlands are regarded as an important avifaunal habitat, providing nesting, perching and shelter for various species. Smaller granivorous birds constantly move between the outer edge of these woodlands and the grassy riverbed (Black-faced Waxbill – Estrilda erythronotos, Violet-eared Waxbill – *Uraeginthus granatinus*, Yellow Canary – *Crithagra flaviventris* and Cape Bunting – *Emberza capensis*).

The herbaceous river channel is extensively grazed by livestock and game, especially during the dry seasons. Some small-scale cultivation also occurs within this habitat. The Ga-Mogara River is subsequently extensively utilized and is in most areas in a degraded state.

The impacts associated with the development within this micro-habitat are displacement due to habitat loss and disturbance, as well as potential collision with the power line (especially potential species using these systems as migratory routes).

Figure 11: Grassy riverbed of the Ga-Mogara River. Note the woody riparian patch in the background.

Small depressions

Throughout the landscape, a series of small depressions are present. These depressions form due to micro-topography variations of the underlying substrates (shallower soils over calcrete), giving rise to low grasslands on pan bottoms (may even be devoid of vegetation). The outer belt of these pans comprises of a mixture of tall shrubs and trees. The pan-like alluvium consists of sandy loam with a fairly high content of calcium and phosphate. The pan soils consist of white (washed) sand and are exposed for most of the year and carry shallow pools for a short period following sufficient rains.

During the time of the survey most of these depressions where inundated.

These depressions are characterised by a low growing vegetation layer, mainly grasses and dwarf shrubs such as *Cynodon dactylon, Panicum coloratum, Aristida congesta, A. adscensionis, Enneapogon desvauxii, Eragrostis echinochloidea, E. lehmanniana, Chrysocoma ciliata, Pentzia ciliata,* and *Persicaria serrulata*. These grassy depressions are typically surrounded by a fringe of small to medium-sized trees such as *Vachellia karroo, Senegalia mellifera, Ziziphus mucronata, Grewia flava,* and *Diospyros lycioides*.

Most of these depressions are still largely natural. Some of these depressions contain low gravel obstructions which were constructed in an attempt to contain the surface water for long periods following rainfall events although these structures have not greatly affected the functioning and character of the wetlands.

The inundated areas of the larger depression wetland were utilized waterfowl and other water loving species such as Little Grebe – *Tachybaptus ruficollis*, Red-knobbed Coot - *Fulica cristata*, Red-Billed Teal – *Anas erytrorhyncha*, African Spoonbill - *Platalea alba*, Cape Shoveler – *Anas smithii*, Egyptian Goose - *Alopechen aegyptiaca*, and Black-winged Stilt - *Himantopus himantopus.*

The edge of the inundated areas was waded by Marsh Sandpiper - *Tringa stagnatilis* and Three-banded plover - *Charadrius tricollaris*.

The depression wetlands provide important sources of water and food in the form of protozoans and small branchiopods which become active during sufficient inundation.

Current land use within this habitat includes predominantly game and stock farming

The major impacts associated with this habitat include potential collisions with the power line (larger species such as Egyptian Goose, South African Shelduck and the Sandgrouse species).

Figure 12: Inundated depression wetland (Pan). African Spoonbill wading for small invertebrates.

Figure 13: Another inundated depression wetland with a relative dense woody riparian fringe.

Artificial landscapes

Cleared servitude underneath the existing power lines as well as the associated servitudes

Artificial habitats are provided by the existing overhead power lines as well as the cleared servitudes. The pylons along the central portion of the 275kV line (area traversing the dense *A. erioloba* woodland) are used as perching and roosting sites by White-backed Vultures (*Gyps africanus*), Martial Eagle (*Polemaetus bellicosus*), Common Buzzard (*Buteo buteo*), Greater Kestrel (*Falco rupicoloides*), Red-footed Falcon (*Falco vespertinus*) and Pied Crow (*Corvus albus*). The southern half of the 275kV line (between the N14 and the Olifantsloop River) contains numerous Sociable Weaver Nests (*Philetairus socius*). The only large raptor nest noted during the survey was very old and abandoned with no active nests noted.

The cleared servitudes are dominated by an open grassland with a sparse covering of low growing shrubs such as *Tarchonanthus camphoratus*, *Grewia flava* and small *V. erioloba* trees resettling in these areas. Grass species dominant within the servitude include *Aristida adscensionis, A. meridionalis, A. congesta, Enneapogon cenchroides, Eragrostis lehmanniana, E. echinochloidea, E. trichophora, Schmidtia kalihariensis, Stipagrostis ciliate* and *S. uniplumis*. The 275kV power line servitude is characterised by species such as Spike-heeled Lark (*Chersomanes albofasciata*), Monotonous Lark (*Mirafra passerine*), Goundscraper Thrush (*Turdus litsitsirupa*), Kalahari Scrub Robin (*Cercotrichas paena*), Ant-eating Chat (*Myrmecocichla formicivora*), Scaly-feathered Weaver (*Sporopipes*

squamifrons), Capped Wheatear (*Oenanthe pileata*) and Rufous-cheeked Nightjar (*Caprimulgus rufigena*).

The risk of birds colliding with the overhead power lines is not expected to exponentially increase as a result of this development, as the proposed power line runs for large parts parallel to and in close proximity to the existing transmission lines and therefore will not pose an altogether new risk to avifauna in the area. Having said this, it is still regarded as good practice to improve visibility of the line for especially the larger raptors such as the Martial Eagles (*Polemaetus bellicosus*), Secretary birds (*Sagittarius serpentarius*), vulture species and larger ground species such as Korhaans and Kori Bustards (*Ardeotis kori*) as well as for Sandgrouse species, especially in areas where these species are abundant and mobile. The dense *V. erioloba* woodland is regarded as such an area and subsequently it is recommended that mitigation measures, such as bird flappers, are implemented in this area to make the line more visible.

The proposed grid connection corridor will traverse a largely impacted veld and the addition of a power line in this area may increase an additional risk for collision by avifaunal species (especially for korhaan species, Kori Bustards and Secretary birds) as a new area of power line will be created.

Figure 14: Existing 275kV line with a sociable weavers' nest.

<u>Olifantshoek sewage works</u>

Even though this area is located outside of the assessed corridor, it is still important to take this artificial habitat into account. It is a permanent source of water creating a habitat for

water fowls, waders, herons and other bird species associated with such habitats. These species' route between this water source and the gravel dam located to the south of the town may cross the proposed power line. Species noted within this artificial habitat included: Egyptian Goose (*Alopechen aegyptianca*), South African Shelduck (*Tadorna cana*), Yellow-Billed Duck (*Anas undulata*), Cape Shoveler (*Anas smithii*), Red-billed Teal (*Anas erythrorhyncha*), Little Grebe (*Tachybaptus ruficollis*), Crowned Lapwing (*Vanellus coronatus*), Kittlitz's Plover (*Charadrius pecuarius*) and Three-banded Plover (*Charadrius ticollaris*).

The impacts associated with the development regarding this micro-habitat are potential collision with the power line. This can be mitigated by implementing visibility measures (bird flappers) along the power line section potentially falling within the flight path of these mentioned bird species.

Avifaunal Species Composition

A total of 228 species were recorded in 2722DD and DC by SABAP1 & 2, with 11 species classified as Red Data species (Barnes, 2014). These include Near Threatened Species such as; Black Stork (*Ciconia nigra*), Secretarybird (*Sagittarius serpentarius*) and Black Harrier (*Circus maurus*) and Vulnerable species such as; Cape Vulture (*Gyps coprotheres*), White-backed Vulture (*Gyps africanus*), Lappet-faced Vulture (*Torgos tracheliotus*), Tawny Eagle (*Aquila rapas*), Martial Eagle (*Polemaetus bellicosus*), Corn Crake (*Crex crex*), Kori Bustard (*Ardeotis kori*) and Ludwig's Bustard (*Neotis ludwigii*). Furthermore, 22 species are southern African endemics and 38 are near-endemics (26%).

Reporting rates are an indication of the relative density of a species on the ground in that it reflects the number of times that a species was recorded relative to the total number of cards that were completed for the pentad 1.

During the site survey, a total of 106 bird species were recorded within the study area with 9 species being endemic and 28 being near-endemic.

The most commonly recorded species within the study area were passerine and near passerine species of which Bokmakierie (*Telophorus zeylonus*), Crimson-breasted Shrike (*Laniarius atroccineus*), Lesser Grey Shrike (*Lanius minor*), Fork-tailed Drongo (*Dicrurus adsimilis*), Monotonous Lark (*Mirafra passerine*), Black-chested Prinia (*Prinia flavicans*), Yellow-bellied Eremomela (*Eremomela icteropygialis*), Southern Pied Babbler (*Turdoides bicolor*), Kalahari Scrub Robin (*Cercotrichas coryphoeus*), Ant-eating Chat (*Myrmecocichla formicivora*), Sociable Weaver (*Philetairus socius*), Scaly-feathered Weaver (*Sporopipes squamifrons*), and Chestnut-vented Warbler (*Sylvia subcaerulea*).

Endemic species recorded during the site survey included South African Shelduck (*Tadorna cana*), White-backed Mousebird (*Colius colius*), Ant-eating Chat (*Myrmecocichla formicivora*), Rufous-eared Warbler (*Malcorus pectoralis*), Southern Pied Barbet (*Turdoides bicolor*), Karoo Scrub Robin (*Cercotrichas caryphoeus*), Sickle-winged Chat (*Emarginata sinuata*), Northern Black Korhaan (*Afrotis afraoides*) and Sociable weaver (*Philetairus socius*).

Red listed species recorded within and around the development footprint area included White-backed Vulture - *Gyps africanus* (Endangered), Martial Eagle – *Polemaetus bellicosus* (Endangered), Red-footed Falcon – *Falco vespertinus* (Global: Near Threatened), Peregrine Falcon - *Falco peregrinus* (Near Threatenedz) and Kori Bustard - *Ardeotis kori* (Near Threatened). Listed avifaunal species were not recorded within the site, although highly likely to occur within the area include, Secretary Bird - *Sagittarius serpentarius* (Vulnerable) and Lanner Falcon – *Falco biarmicus* (Vulnerable).

Avifaunal Species of Conservation Concern

Table 4 provides a guideline of the Red Data species that have and could potentially be encountered anywhere within the pentad where suitable habitat is available. This was based on observations of avifauna and micro-habitats during the site survey, in combination with documented records within the study area.

Report rates are the likelihood of a particular species occurring within the study site represented as a percentage. Due to the lack of atlas records and subsequent inaccuracies with regards to reporting rates within the proposed study site, these were not included in the analysis.

The specific habitat requirements for each species as well as the most likely associated impacts due to the development were recorded. Species that are in bold were recorded during the site survey.

Table 4: Red listed as well as one species that is not listed that has been recorded either within the relevant quarter degree squares, on site during survey or has a possibility of occurring within the area and which will potentially be affected by the proposed development (NT = Near Threatened; VU = Vulnerable; EN = Endangered; LC = Least Concern) (Species that are in bold were recorded during the site survey; X=impact is relevant to this species)

Name	Conservation Status	Habitat	Likelihood of Occurence	Habitat Destruction	Disturbance	Collision with Power Line	Electrocution	Endemic
Secretary Birds *Sagittarius serpentarius*	VU	Grassland/Open Woodland	Likely	X	X	X		
Martial Eagle *Polemaetus bellicosus*	EN	Woodland/Savannah	Present	X	X	X	X	
Kori Bustard *Ardeotis kori*	NT	Grassland/Thornveld	Highly Likely	X	X	X		
White-backed Vulture *Gyps africanus*	EN	Woodland/Savannah	Present	X	X	X	X	Near-Endemic
Red-footed Falcon *Falco vespertinus*	NT	Woodland/Savannah	Present		X		X	Endemic
Lanner Falcon *Falco biarmicus*	VU	Woodland/Savannah	Likely		X		X	
Peregrine Falcon *Falco peregrinus*	NT	Woodland/Savannah	Present		X		X	

6. SENSITIVITY ASSESSMENT

It is important to delineate sensitive avian habitats within the study area in order to ensure the development does not have a long-term negative impact on these habitats. Important avian habitats play an integral role in their persistence within a landscape providing nesting, foraging and reproductive benefits

A sensitivity map was compiled for the study area by making use of the results of the avifaunal micro-habitat assessment (refer to Figure 15).

A large portion of the study area has been assessed as being of **LOW** sensitivity from an avifaunal perspective. The majority of the development footprint falls within the tree savanna and shrub savanna habitats and is considered to be of **LOW** avifaunal sensitivity, apart from the taller woodland clusters which have been assessed as **MEDIUM** sensitivity Apart from the "unique" patches of tall woodlands, these tree and shrub savanna habitats have been assessed as LOW due to the homogenous nature of the vegetation within the region, furthermore these habitat types has an extensive distribution outside of the study area and thus does not represent a specific niche habitat such as the woodland savanna patches. The encroachment of *S. mellifera* also contributes to the relatively low diversity of avifaunal species within the shrubland savanna habitat, as the encroaching bush has resulted in some of the lark species moving out of the denser areas. The larger *S. mellifera* species still none-the-less provide protective nesting areas for some smaller bird species such as Black-chested Prinia and possibly Pririt Batis. Acceptable change includes the alteration of habitat within the development footprint and servitude and some loss of potential nesting sites within these areas due to the clearing of large shrubs and tree species, however most of these species will move into the surrounding unaffected habitats.

The dense *V. erioloba* woodland located approximately 1.5km north of the N14 has been assessed as **MEDIUM** Sensitive due to the movement of the red data birds such as Martial Eagle, Cape Vulture and Kori Bustard within this area. Both the Martial Eagle and the Cape Vultures recorded within this area, were found perching on the 275kV power line. By implementing mitigations measures to ensure the visibility of the power line (e.g. bird flappers) the risk of collision by these red data species can be significantly reduced.

Acceptable change includes the alteration of habitat within the development footprint and servitude and some loss of potential tree nesting sites within these areas due to the clearing of large shrubs and tree species, however most of these species will move into the surrounding unaffected habitats. No loss of potential active nests belonging to Secretary birds (unlikely to occur) and Kori Bustards (likely to occur although no species were recorded during the survey) may be allowed. If such nests are observed during the pre-construction walk through or during construction mitigation measures should be implemented as specified within Section 5 (Impact Assessment).

The southern portion of the power line corridor is classified as **MEDIUM** sensitivity due to its proximity (less than 550m) to the town's sewage works. This artificial habitat provides a permanent waterbody inhabited by various water fowl and waders. These species likely move between the sewage works and the dam located at the southern point of the town and their flight path most likely crosses this section of the proposed power line corridor. By implementing mitigation measures to ensure the visibility of the power line (e.g. bird flappers) this risk can be significantly reduced. Acceptable change within this habitat include, ONLY habitat transformation within the footprint area and associated servitude. Any change in the water fowl and wader population due to excessive power line collisions is not acceptable and should be prevented by implementing sufficient anti-collision mitigation measures as specified above and within Section 5 (Impact Assessment).

The non-perennial watercourse (Ga-Mogara River) with its associated tree fringe as well as the depression wetlands with their woody peripheries have been classified as **HIGH** sensitivity. Such ephemeral river systems and their associated riparian fringes are normally associated with important migration corridors for avifaunal species. Furthermore, the tree fringes of the Ga-Mogara River and depression wetlands are associated with a diversity of avifaunal species of which a number are dependent on these areas for nesting, feeding and potential short distance migratory routes. The depression wetlands provide important sources of water and food in the form of protozoans and small branchiopods which become active during sufficient inundation. By implementing mitigation measures to ensure the visibility of the power line (e.g. bird flappers) this risk can be significantly reduced around these sensitive features. The depression wetlands should be regarded as NO-GO areas. Acceptable change within the area of the Ga-Mogara to be crossed include, ONLY habitat transformation within the footprint area and associated servitude. No riparian woodlands may be impacted, and such areas should be regarded as NO-GO areas. Any change in the potential water fowl and wader populations as well as well as within migratory faunal populations due to excessive power line collisions is not acceptable and should be prevented by implementing sufficient anti-collision mitigation measures as specified above and within Section 5 (Impact Assessment).

From the described sensitive areas and the location of the proposed development footprint area relative to these areas, it can be concluded that the majority of the proposed development will occur within a **LOW** sensitivity avifaunal area with some of the proposed footprint traversing **MEDIUM** sensitivity areas with only small portions crossing **HIGH** sensitivity areas.

Overall, it was concluded that with the necessary mitigation measures implemented this **development will have little impact on the avifaunal character of the area with minimal loss due to collision.**

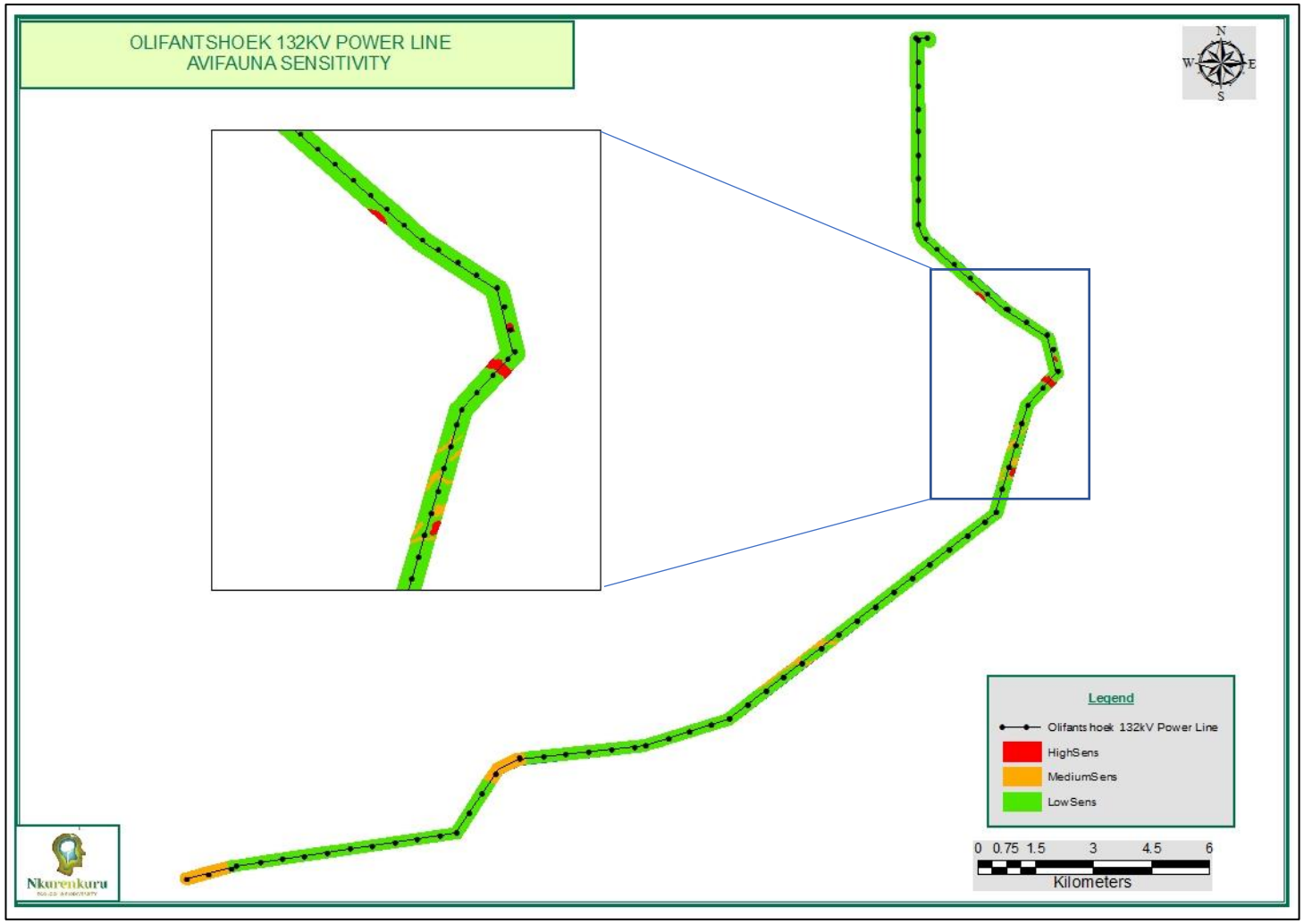

Figure 15: Map illustrating the Avifuana Sensitivity of the project site.

7. ASSESSMENT OF PROPOSED IMPACTS

Impact Statement

The implications of the proposed development are as follows:

» Vegetation within a 31m wide servitude, extending the length of the power line, will be altered to some extent, although still deemed largely suitable to various avian species.
» During the construction phase of the power line, disturbance levels will be significantly higher in the immediate vicinity than previously. This disturbance will result from machinery and vehicle disturbance as well as other construction activities.
» During the operational phase, there will be some vehicle activity during maintenance of the power line.
» The power line will potentially pose a collision risk to avifauna, particularly heavier birds with low manoeuvrability (specifically the resident Bustard species).
» The power line towers and the substation infrastructure provide perching and nesting structures for various avifauna, particularly larger raptors.
» There is a possibility that species such as crows/owls could be electrocuted on the substation infrastructure.

Identification of Potential Impacts and Associated Activities

Potential bird impacts regarding transmission lines comprise of electrocution, collision and disturbances caused during the construction and maintenance of transmission lines. It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with power lines.

These include the following.

Electrocution

Electrocution happens when a bird bridges the gap between the live components or a combination of a live and earth component of a power line, thereby creating a short circuit. This happens when a bird, mainly a species with a fairly large wingspan attempts to perch on a pylon or attempts to fly-off a pylon. These larger species will attempt to roost and even breed on the pylon structures if available nesting platforms are a scarce commodity.

Other types of electrocutions happen by means of so-called "birdstreamers". This happens when a bird, especially when taking off, excretes and thereby causing a short-circuit

through the fluidity excreta (Van Rooyen & Taylor, 1999). This method of electrocution is however a rare phenomenon.

Large transmission lines (from 220kV to 765kV) are seldom a risk of electrocution, although smaller distribution lines (88 – 132kV) pose a higher risk.

Collision

Collisions with earth wires have probably accounted for most bird-transmission line interactions in South Africa. In general, the earth wires are much thinner in diameter when compared to the live components, and therefore less visible to approaching birds. Many of the species likely to be affected include heavy, large-bodied terrestrial species such as cranes, storks, flamingos, bustards, korhaans, Secretarybirds and a variety of waterbirds that are not very agile or manoeuvrable once airborne. These species, especially those with the habit of flying with outstretched necks (e.g. most species of storks and flamingos) find it difficult to make a sudden change in direction while flying – resulting in the bird flying into the earth wires.

Habitat destruction and physical disturbance during construction and maintenance

Access roads and laydown areas will need to be constructed, including the clearing of vegetation as part of the power line servitude. Subsequently, clearing and removal of vegetation is likely to take place underneath the power line. The placement of access roads and laydown areas (for the poles and stringing material) next to habitat features with a high probability of sustaining congregations of bird species (e.g. pans) or along drainage lines and rivers is likely to disrupt the natural movement of bird species or it could result in the abandoning of these areas. Therefore, special care should be taken near drainage lines, rivers, pans and dams as not to disturb the bird community or the vegetation structure.

Habitat destruction is not considered to be a major impact since many of the bird species will temporarily vacate the area during the construction phase. It is inevitable that most bird species (including the smaller passerine) will be affected by road construction, the construction of pylons and stringing operations. However, the impact is considered to be more severe within or in close proximity to pans, watercourses and drainage lines, and could displace large-bodied bird species (especially if these are breeding in the proximal vicinity within 100m). Typical species include foraging and breeding large-bodied terrestrial bird taxa.

Disturbances during construction and maintenance is unavoidable. These will especially be significant near or in close proximity to dams. Although it is not anticipated to pose a significant impact on bird species, special care should be exercised during the crossing of

wetland and watercourse systems to prevent unnecessary disturbances caused to potential breeding and roosting species.

Assessment of Impacts

Planning and Construction Phase

Impact 1: Habitat Destruction

Impact Nature:

During the **construction** of the power line, some habitat destruction and alteration will occur, although this is will be limited. These activities may have a very slight impact on foraging, breeding and roosting ecology of avian species within the area through modification of habitat.

It is envisaged that the only Red Data species that may be potentially displaced (temporarily) by the activities and habitat transformation that will take place as a result of construction are Kori bustard (*Ardeotis kori*). This displacement will only be from a very restricted area. The impact on smaller, non-Red Data species that are potentially breeding in the area will be local and very restricted in extent, and will not have a significant effect on regional or national populations.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (3)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**Medium (40)**	**Low (21)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	Only very slight loss of resources	Only very slight loss of resources
Can impacts be mitigated?	Yes, impacts mostly limited to construction phase:	
Mitigation	» The temporal and spatial footprint of the development should be kept to a minimum. » The boundaries of the development footprint are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area. » Open fires are strictly prohibited and only allowed at designated areas. » Provide adequate briefing for site personnel on the possible important (Red Data) species occurring and/or nesting in the area and the procedures to be followed in this regard (for example notification of ECO and avoidance of area until appropriate recommendations have been provided by a specialist).	

	» The above measures must be covered in a site specific EMPr and monitored by an ECO.
Residual Impacts	Some residual habitat loss will result from the development, equivalent to the operational footprint of the power line.

Impact 2: Disturbance during construction

Impact Nature:

Disturbance, transformation, and loss of habitat will have a negative effect on resident avifauna during construction.

Species sensitive to disturbance include ground-nesting species resident within the development footprint. Disturbance can also influence the community structure of avifauna within close proximity to the development as certain species will be displaced and forced to find alternative territories.

Disturbance could have a negative impact on the breeding activities of various species, particularly if this occurs during a sensitive period in the breeding cycle.

Species of concern are Kori Bustard. Other small avian species do occur within the development footprint, but these species are non-Red Data species.

Increased levels of noise, pollution, disturbance, and human presence during the construction phase may affect the local avifauna. Sensitive and shy avifauna would move away from the area during the construction phase and may move back into the area upon completion of the construction phase.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Low (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Low (28)**	**Low (21)**
Status	Negative	Negative
Reversibility	High	Medium
Irreplaceable loss of resources	Only very slight loss of resources	Only very slight loss of resources
Can impacts be mitigated?	Impacts can be mitigated to a large extent. Large amounts of noise and disturbance at the site during construction are largely unavoidable.	
Mitigation	» Strict control must be maintained over all activities during construction, in line with an approved construction EMPr. » During construction, if any of the Red Data species identified in this report are observed to be roosting and/or breeding in the vicinity, the ECO must be notified and were deemed necessary an appropriate buffer should be placed around the nests and/or roosting areas. If uncertain on the size of such buffer the Environmental Officer (EO) may contact an avifaunal specialist for advice.	

	» The construction equipment camps must be as close to the site as possible and within disturbed areas as far as possible. » Contractors and working staff must remain within the development footprint and movement outside these areas especially into avian micro-habitats must be restricted. » Driving must take place on existing roads and a speed limit of 30km/h must be implemented on all roads associated with the project during the construction phase. » Breeding, egg laying and incubation occur typically between October and February for Kori bustard and most of the sensitive ground nesting avifaunal species. During these months' disturbances within natural and near-natural habitats should be limited as far as possible.
Residual Impacts	There will be minimal residual impact as the facility will have low operational impacts on avifauna, after the construction phase.

Operational Phase Impacts

Impact 3: Disturbance during maintenance

Impact Nature:

Disturbance during operational phase (movement and maintenance along the route), may have a negative effect on resident avifauna during construction.

Species sensitive to disturbance include ground-nesting species resident within the development footprint. Disturbance can also, for the duration of maintenance, influence the community structure of avifauna within close proximity to the development as certain species will be temporarily displaced and forced to find alternative territories.

Disturbance could have a negative impact on the breeding activities of various species, particularly if this occurs during a sensitive period in the breeding cycle.

Species of concern are Kori Bustard. Other small avian species do occur within the development footprint, but these species are non-Red Data species.

Increased levels of noise, pollution, disturbance, and human presence during maintenance may affect the local avifauna.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Very short duration (1)	Very short duration (1)
Magnitude	Minor (3)	Small (1)
Probability	Probable (3)	Improbable (2)
Significance	**Low (15)**	**Low (6)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	Only very slight loss of resources	Unlikely

Can impacts be mitigated?	Impacts can be mitigated to a large extent. Large amounts of noise and disturbance at the site during maintenance operations are largely unavoidable.
Mitigation	» Strict control must be maintained over all activities during maintenance, in line with an approved EMPr. » During monitoring and maintenance, if any of the Red Data species identified in this report are observed to be roosting and/or breeding in the vicinity, Eskom's EO must be notified and were deemed necessary an appropriate buffer should be placed around the nests and/or roosting areas. If uncertain on the size of such buffer the Environmental Officer (EO) may contact an avifaunal specialist for advice. » Contractors and working staff should remain within the servitude footprint and movement outside these areas especially into avian micro-habitats must be restricted. » Driving must take place on existing roads and a speed limit of 30km/h must be implemented on all roads associated with the project during the operation (including maintenance) phase. » Breeding, egg laying and incubation occur typically between October and February for Kori bustard and most of the sensitive ground nesting avifaunal species. During these months' disturbances within natural and near-natural habitats should be limited as far as possible.
Residual Impacts	Residual impacts as a result of maintenance activities is unlikely

Impact 4: Electrocution of birds due to overhead power lines

Impact Nature:

Electrocution of birds on associated overhead power lines is an important cause of mortality for a variety of large bird species particularly storks, cranes and raptors in South Africa (Van Rooyen & Ledger, 1999). Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004; Lehman *et al*., 2007).

The impact assessment found the impact of electrocution to be of moderate significance before mitigation, and low significance after the mitigation in the form of bird friendly structures.

	Without Mitigation	**With Mitigation**
Extent	Larger Surroundings (3)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (39)**	**Low (16)**
Status	Negative	Negative
Reversibility	Low	Medium

Irreplaceable loss of resources	Yes, owing to the potential loss of critically endangered or endangered bird species	Low potential for irreplaceable loss of resources
Can impacts be mitigated?	Mitigation is very difficult to prescribe at this stage. It is suggested that the impact be monitored by the operations environmental manager and should it be found to be a significant impact a suitably qualified avifaunal specialist be consulted to recommend suitable mitigation.	
Mitigation	» Position electrical infrastructure in close proximity to existing infrastructure (e.g. existing roads and power lines). » A "Bird Friendly" structure, with a bird perch (as per standard Eskom guidelines) must be used for the tower structures. » All relevant perching surfaces should be fitted with bird guards and perch guards as deterrents (Hunting, 2002). » Installation of artificial bird space perches and nesting platforms should be installed, at a safe distance from energised components (Goudie, 2006; Prinsen *et al*., 2012). » Line inspections should be ongoing for the operational life of the line.	
Residual Impacts	Direct mortality is possible and may still happen irrespective of applied mitigation measures. The residual impacts should subsequently be regarded as medium.	

Impact 5: Collisions of birds with overhead power line

Impact Nature:

Collisions are the biggest single threat posed by transmission power lines to birds in Southern Africa (van Rooyen, 2004). Avian species most susceptible and impacted upon are bustards, storks and cranes (especially bustards which have been confirmed are at risk within the project site). These species are heavy-bodied birds with limited manoeuvrability (as a result of high wing loading), which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (Van Rooyen 2004, Anderson 2001). Many of the collision sensitive species are considered threatened in Southern Africa.

The Red Data species that are vulnerable to power line collisions are generally long living, slow reproducing species. Furthermore, various species require specific conditions for breeding, resulting in very few successful breeding attempts and breeding might be restricted to very small areas. Consistent high adult mortality over an extensive period could have a serious long-term effect on the population.

Potential collision impacts (risk) with the proposed power line by certain species such as Kori Bustard and Secretarybird are possible. This is particularly true for the bustards which have low manoeuvrability once in flight. All three species mentioned have been recorded within the top ten avian species in South Africa prone to collisions with overhead power lines.

	Without Mitigation	**With Mitigation**
Extent	Larger Surroundings (3)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Probable (3)

Significance	**Moderate (52)**	**Low (27)**
Status	Negative	Negative
Reversibility	Low (birds will be injured or killed)	Low (birds will be injured or killed)
Irreplaceable loss of resources	Medium	Low
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» Construction of the power line in close proximity to the existing lines will reduce the cumulative impacts and collision risk. » All relevant perching surfaces must be fitted with bird guards and perch guards as deterrents (Hunting, 2002). » Mark sections of line in high sensitivity areas with anti-collision marking devices (diurnal and nocturnal diverters) to increase the visibility of the power line and reduce likelihood of collisions. Marking devices should be spaced 10m apart. » These line marking devices include spiral vibration dampers, strips, Bird Flight Diverters, bird flappers, aerial marker spheres, ribbons, tapes, flags and aviation balls (Prinsen *et al.,* 2012). » It is proposed that sections of the line in close proximity to rivers, wetlands and dams (including evaporation ponds of the local sewage works) be fitted with "Double Loop Bird Flight Diverters" (BFDs). This includes the section of line spanning the Ga-Mogara River. » The risk of collision is particularly high where the proposed servitude traverse across corridors for avifaunal movement between dams, wetlands and other water bodies that are generally within 300m of the power line. Such a corridor for movement is likely present between the Olifantshoek dam to the south-west and the evaporation ponds of the towns' sewage works to the north-east and anti-collision marking devices should be installed along the line section that falls within the flight corridor. » The power line should, as far as possible, be placed parallel to existing power lines or other linear infrastructure such as roads, as this will also greatly increase the visibility of the overhead cables	
Residual Impacts	Low. The power line will be within the area over a long period of time if not permanent. However, if the power line is removed the impacts associated (avian mortalities) will cease.	

Assessment of Cumulative Impacts

Cumulative Impact 1: Regional losses of natural habitat

Impact Nature: Regional losses of natural habitat and subsequently displacement of birds

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long-term (4)	Long-Term (4)
Magnitude	Minor (2)	Moderate (6)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Moderate	Low
Irreplaceable loss of resources	Only very slight loss of resources	Yes
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» Consolidate infrastructure to areas where existing impacts occur (e.g. placing the proposed power line alongside existing power lines and roads). » The development footprint of the various individual facilities must be kept as small as possible and sensitive habitats must be avoided.	

Cumulative Impact 2: Collisions of birds with overhead power line

Impact Nature: Avian collision impacts related to the overhead power lines during operation		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (3)
Duration	Long-term (4)	Long-Term (4)
Magnitude	Low (4)	Moderate (7)
Probability	Probable (3)	Highly Probable (4)
Significance	**Low (27)**	**Medium (56)**
Status	Negative	Negative
Reversibility	Low (birds will be injured or killed)	Low (birds will be injured or killed)
Irreplaceable loss of resources	Low	Yes, owing to the potential loss of critically endangered or endangered avifaunal species.
Can impacts be mitigated?	Yes, to some extent	

Mitigation	» Apply bird deterrent devices to the power line and make use of "bird-friendly" pylon structures. » Consolidate infrastructure to areas where existing impacts occur (e.g. placing the proposed power line alongside existing power lines and roads). » The development footprint of the various individual facilities must be kept as small as possible and sensitive habitats must be avoided.

Cumulative Impact 3: Electrocution of birds due to overhead power lines

Impact Nature: Avian electrocution related to the power lines during operation.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (2)	Regional (3)
Duration	Long-term (4)	Long-Term (4)
Magnitude	Minor (2)	Moderate (7)
Probability	Improbable (2)	Highly Probable (4)
Significance	**Low (16)**	**Medium (56)**
Status	Negative	Negative
Reversibility	Low (birds will be injured or killed)	Low (birds will be injured or killed)
Irreplaceable loss of resources	Low potential for irreplaceable loss of resources	Yes, owing to the potential loss of critically endangered or endangered avifaunal species.
Can impacts be mitigated?	Yes, to some extent	
Mitigation	» Apply bird deterrent devices to the power line and make use of "bird-friendly" pylon structures. » Consolidate infrastructure to areas where existing impacts occur (e.g. placing the proposed power line alongside existing power lines and roads).	

8. CONCLUSION

The proposed Olifantshoek 132kV Power Line will have a minimal impact on avifauna due to the extensive spatial requirements of the development, the study area being mostly uniform in habitat composition as well as avifaunal composition with small variation

occurring between the different micro-habitats. Therefore, the proposed development is unlikely to have any long-term significant impacts on avifaunal species within the study area. The proposed development of the Olifantshoek 132kV Power Line can be authorised subject to the implementation of the recommended mitigation measures.

During the site survey, a total of 106 bird species were recorded within the study area.

Endemic species recorded during the site survey included South African Shelduck (*Tadorna cana*), White-backed Mousebird (*Colius colius*), Ant-eating Chat (*Myrmecocichla formicivora*), Rufous-eared Warbler (*Malcorus pectoralis*), Southern Pied Barbet (*Turdoides bicolor*), Karoo Scrub Robin (*Cercotrichas caryphoeus*), Sickle-winged Chat (*Emarginata sinuata*), Northern Black Korhaan (*Afrotis afraoides*) and Sociable weaver (*Philetairus socius*).

Red listed species recorded within and around the development footprint area included White-backed Vulture - *Gyps africanus* (Endangered), Martial Eagle – *Polemaetus bellicosus* (Endangered), Red-footed Falcon – *Falco vespertinus* (Global: Near Threatened) and Kori Bustard - *Ardeotis kori* (Near Threatened). Listed avifaunal species not recorded within the site although highly likely to occur within the area include, Secretary Bird - *Sagittarius serpentarius* (Vulnerable), Lanner Falcon – *Falco biarmicus* (Vulnerable) and Peregrine Falcon - *Falco peregrinus* (Near Threatened).

Investigation of the study area revealed the following important avian micro-habitats.

- Open Tree Savanna
- Shrubland Savanna
- Ridges and outcrops
- Non-perennial watercourses
- Small depression wetlands
- Artificial landscapes including:
  d) Cleared servitude underneath the 275kV and 400kV power lines
  e) The 275kV and 400kV power lines
  f) Olifantshoek sewage works

The largest portion of the footprint area fall within the tree and shrub savanna habitats. Both of these habitats have been assessed as low sensitive apart from the patches of tall woodlands scattered through mostly the shrubland savanna, where deeper soils persist. These woodland patches are regarded as Medium sensitive. Other areas assessed as Medium sensitive include the section of the power line that fall within a potential flight path between two perennial water sources (Olifantshoek Dam and the evaporation ponds of the towns' sewage works) and the areas of the surveyed corridor that is located in close proximity to the observation points of the following red data birds; Marshal Eagle, Cape Vulture and Kori Bustard. The ephemeral watercourse (Ga-Mogara River) as well as the

depression wetlands have been assessed as High Sensitive due to the functions and services provided by these habitats.

The overall potential impact on priority avifauna for the construction phase is assessed to be of Moderate to Low significance before mitigation measures, and Low after the implementation of mitigation measures. For the operational phase, the overall potential impact on priority avifauna is assessed with a Low to Medium significance without the implementation of mitigation measures; and Low significance with the implementation of mitigation measures. Cumulative impacts are assessed with a Moderate significance both with and without mitigation measures. In terms of an average, the pre-mitigation significance of all potential impacts identified in this specialist study is assessed as Moderate to Low, leaning more towards Moderate and the post-mitigation significance is assessed as Low.

In order to affectively lower the potential significance of impacts the following recommendations are provided:

» **Electrocution:**
- Position electrical infrastructure in close proximity to existing infrastructure (e.g. existing roads and power lines).
- A "Bird Friendly" structure, with a bird perch (as per standard Eskom guidelines) must be used for the tower structures.
- All relevant perching surfaces should be fitted with bird guards and perch guards as deterrents (Hunting 2002).
- Installation of artificial bird space perches and nesting platforms should be installed, at a safe distance from energised components (Goudie 2006; Prinsen et al. 2012).

» **Collision**
- Areas where bird collisions are likely to be high could be ameliorated by marking the lines with bird devices such as "bird diverters" and "flappers" to increase the visibility of the lines. For the current project it is proposed that sections of the line in close proximity to rivers, wetlands and artificial water sources such as dams and evaporation ponds (associated with sewage works), be fitted with bird diverters. This includes the section of the line spanning the Ga-Mogara river as well as the potential flight corridor between the Olifantshoek dam and evaporation ponds associated with a waste water treatment plant. The risk of collision is also high where the proposed corridors traverse within 300 m of natural depression wetlands.
- In addition, by placing the power line parallel to existing power lines or other linear infrastructure such as roads will also greatly increase the visibility of the overhead cables.

- Al wetland (depression) features and their associated woody peripheries are regarded as No-Go areas. Any portion of the power line that is within a radius of 200m from such features should contain bird diverters.

» **Disturbance of avifaunal species**

- The placement of access roads and laydown areas (for the poles and stringing material) next to habitat features with a high probability of sustaining congregations of bird species (e.g. dams, depression wetlands) or along drainage lines and rivers is likely to disrupt the natural movement of bird species or it could result in the abandoning of these areas. Therefore, special care should be taken near drainage lines, rivers, pans and dams as not to disturb the bird community or the vegetation structure.
- The patches of tall riparian woodland associated with the Ga-Mogara River should be regarded as No-Go areas.

9. REFERENCES

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

Allan, D.G.1996b. Population structure and breeding habits of the Blue Crane *Anthropoides paradiseus* in the Western Cape Province and Karoo, South Africa. In Beilfuss R et al. (eds), *The African Crane and Wetland Training Workshop,* Maun, Botswana, 1993. International Crane Foundation pp. 355-376.

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

Goudie, R.I., 2006. Effects of power lines on birds. Harlequin Enterprises. St. John's, Newfoundland.

Harrison, J.A., Allan. D.G., Underhill, L.G., Herremans, M., Tee, A.J., Parker, V., Brown, C.J (eds). 1997. The atlas of southern African Birds. Vol. 1 & 2. BirdLife South Africa: Johannesburg.

Herholdt, J.J., Anderson, M.D. 2006. Observations on the population and breeding status of the African Whitebacked Vulture, the Black-chested Snake Eagle, and the Secretarybird in the Kgalagadi Transfontier Park. Ostrich 77, 127-135.

Hunting, K., 2002. A roadmap for PIER research on avian power line electrocution in California. California Energy Commission, California.

Jenkins, A.R., Smallie, J.J. & Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International 20: 263-278.

Jenkins, A., Smallie, J. 2009. Terminal Velocity. End of the line for Ludwig's Bustard? Africa – Birds and Birding. 35 – 39.

Kagan, R.A., T.C. Viner, P.W. Trail, and E.O. Espinoza. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. National Fish and Wildlife Forensics Laboratory.

King, D.I. & Byers, B.E. 2002. An evaluation of power line rights-of-way as habitat for early-successional shrubland birds. Wildlife Society Bulletin 30: 868-874.

Lehman, R.N., Kennedy, P.L. & Savidge, J.A. 2007. The state of the art in raptor electrocution research: a global review. Biological Conservation 136: 159-174.
Alexander, G. & Marais, J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Nature, Cape Town.

Maclean, G.L. 1999. Southern African endemic birds: Their distribution and conservation. Ostrich 69: Iss. 1-2.

Marnewick MD, Retief EF, Theron NT, Wright DR, Anderson TA. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.
Martin, G.R., Shaw, J.M. 2010. Bird collisions with power lines: Failing to see the way ahead? Biological Conservation. 2695-2702.

Mucina, L., Rutherford, M.C. & Powrie, L.W. (eds) 2006. Vegetation Map of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Prinsen, H.A.M., Smallie, J.J., Boere, G.C., Pires, N. 2012. Guidelines on how to avoid or mitigate impact of electricity power grids on migratory birds in the African-Eurasian region. Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) Conservation Guidelines No. 14.

Scott-Shaw, C.R and Escott, B.J. (Eds) (2011) KwaZulu-Natal Provincial Pre-Transformation Vegetation Type Map – 2011. Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.

Shaw, J.M., Jenkins, A.R., Smallie, J.J. & Ryan, P.G., 2010. Modelling power-line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. Ibis 152: 590-599

Smit, H.A. 2012. Guidelines to minimize the impact on birds of solar facilities and associated infrastructure in South Africa. BirdLife South Africa, Johannesburg.

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

10. APPENDICES

Appendix 1: List of avifauna recorded within the surveyed corridor

English Family	Scientific	Endemic Status	Red Data Status	Avifaunal Micro-Habitats					
				Tree Savanna	Savanna Shrubland	Pans/ Depressions	Rivers	Ridge	Artificial Habitats
Babbler Southern Pied	*Turdoides bicolor*	Endemic		1					
Chat Ant-eating	*Myrmecocichla formicivora*	Endemic		1					
Chat Sickle-winged	*Cercomela sinuata*	Endemic			1				
Korhaan Northern Black	*Afrotis afraoides*	Endemic		1	1				
Mousebird White-backed	*Colius colius*	Endemic				1	1		
Shelduck South African	*Tadorna cana*	Endemic				1			1
Warbler Rufous-eared	*Malcorus pectoralis*	Endemic			1				
Weaver Sociable	*Philetairus socius*	Endemic		1					
Tit Ashy	*Parus cinerascens*	Near Endemic		1					
Barbet Acacia Pied	*Tricholaema leucomelas*	Near Endemic		1			1		
Batis Pririt	*Batis pririt*	Near Endemic				1		1	
Bokmakierie Bokmakierie	*Telophorus zeylonus*	Near Endemic		1	1	1			
Canary Yellow	*Crithagra flaviventris*	Near Endemic		1	1	1	1	1	
Fawn-coloured Lark	*Calendulauda africanoides*	Near Endemic			1				
Finch Scaly-feathered	*Sporopipes squamifrons*	Near Endemic		1	1			1	
Flycatcher Marico	*Bradornis mariquensis*	Near Endemic		1					
Goshawk Southern Pale Chanting-	*Melierax canorus*	Near Endemic							1
Hornbill Southern Yellow-billed	*Tockus leucomelas*	Near Endemic		1					
Lark Eastern Clapper	*Mirafra fasciolata*	Near Endemic		1	1				
Lark Monotonous	*Mirafra passerina*	Near Endemic		1					
Lark Sabota	*Calendulauda sabota*	Near Endemic		1	1				
Lark Spike-heeled	*Chersomanes albofasciata*	Near Endemic			1		1		
Prinia Black-chested	*Prinia flavicans*	Near Endemic		1	1	1	1	1	
Red-crested Korhaan	*Lophotis ruficrista*	Near Endemic		1					
Robin Kalahari Scrub-	*Erythropygia paena*	Near Endemic		1	1	1	1	1	
Sandgrouse Burchell's	*Pterocles burchelli*	Near Endemic		1	1				
Sandgrouse Namaqua	*Pterocles namaqua*	Near Endemic		1					
Shoveler Cape	*Anas smithii*	Near Endemic							1
Shrike Crimson-breasted	*Laniarius atrococcineus*	Near Endemic		1					
Sparrow Cape	*Passer melanurus*	Near Endemic							1
Spurfowl Red-billed	*Pternistis adspersus*	Near Endemic		1					
Swift Bradfield's	*Apus bradfieldi*	Near Endemic		1				1	

Tit Cape Penduline-	*Anthoscopus minutus*	Near Endemic		1	1				
Tit-Babbler Chestnut-vented	*Sylvia subcaerulea*	Near Endemic		1	1	1	1	1	
Whydah Shaft-tailed	*Vidua regia*	Near Endemic		1			1		
Bee-eater European	*Merops apiaster*			1					1
Bee-eater Swallow-tailed	*Merops hirundineus*			1		1			
Blacksmith Lapwing	*Vanellus armatus*				1	1	1		
Brubru	*Nilaus afer*			1	1				
Bunting Golden-breasted	*Emberiza flaviventris*			1	1		1		
Buzzard Steppe	*Buteo buteo*								1
Crow Pied	*Corvus albus*								1
Dove Cape Turtle-	*Streptopelia capicola*			1			1		
Dove Laughing	*Spilopelia senegalensis*			1	1	1			1
Dove Namaqua	*Oena capensis*			1	1				
Drongo Fork-tailed	*Dicrurus adsimilis*			1					
Duck Yellow-billed	*Anas undulata*					1			1
Eagle Martial	*Polemaetus bellicosus*		VU	1					
Eremomela Yellow-bellied	*Eremomela icteropygialis*			1	1	1			
Falcon Pygmy	*Polihierax semitorquatus*			1					
Falcon Red-footed	*Falco vespertinus*		NT (Global)						1
Firefinch Red-billed	*Lagonosticta senegala*			1					
Fiscal Common	*Lanius collaris*			1	1				1
Goose Egyptian	*Alopochen aegyptiaca*								1
Grebe Little	*Tachybaptus ruficollis*					1			1
Guineafowl Helmeted	*Numida meleagris*			1	1				
Hoopoe African	*Upupa africana*								
Hornbill African Grey	*Tockus nasutus*			1					
Kestrel Greater	*Falco rupicoloides*								1
Kite Black-shouldered	*Elanus caeruleus*			1					1
Lapwing Crowned	*Vanellus coronatus*				1		1		
Nightjar Rufous-cheeked	*Caprimulgus rufigena*			1					
Pigeon Speckled	*Columba guinea*				1				1
Pipit African	*Anthus cinnamomeus*				1		1		
Plover Kittlitz's	*Charadrius pecuarius*					1			1
Plover Three-banded	*Charadrius tricollaris*					1			1
Roller Lilac-breasted	*Coracias caudatus*			1					
Scimitarbill Common	*Rhinopomastus cyanomelas*			1					
Shrike Lesser Grey	*Lanius minor*			1	1				

Starling Cape Glossy	*Lamprotornis nitens*			1					
Stilt Black-winged	*Himantopus himantopus*					1			1
Sunbird Marico	*Cinnyris mariquensis*			1	1	1		1	
Swallow Greater Striped	*Cecropis cucullata*			1					
Swift Common	*Apus apus*			1					
Swift Horus	*Apus horus*			1	1				
Swift Little	*Apus affinis*			1					
Teal Cape	*Anas capensis*								1
Teal Red-billed	*Anas erythrorhyncha*					1			1
Thrush Groundscraper	*Psophocichla litsitsirupa*			1					
Vulture White-backed	*Gyps africanus*		VU	1					1
Waxbill Blue	*Uraeginthus angolensis*			1	1		1		
Waxbill Violet-eared	*Uraeginthus granatinus*			1	1				
Weaver Southern Masked-	*Ploceus velatus*					1			
Weaver White-browed Sparrow-	*Plocepasser mahali*			1	1				
Wheatear Capped	*Oenanthe pileata*						1		
Woodpecker Golden-tailed	*Campethera abingoni*			1					
Bustard Kori	*Ardeotis kori*		VU	1					
Wheatear Mountain	*Myrmecocichla monticola*							1	
Southern (Common) Fiscal	*Lanius collaris*			1					
Sandpiper Marsh	*Tringa stagnatilis*					1			
Green-backed (Striated) Heron	*Butorides striata*					1			
Cape Wagtail	*Motacilla capensis*					1			
Coot Red-knobbed	*Fulica cristata*					1			
Spoonbil African	*Platalea alba*					1			
African Cuckoo	*Cuculus gularis*			1		1			
Hadeda Ibis	*Bostrychia hagedash*					1			
African Sacred Ibis	*Threskiornis aethiopicus*					1			
Mousebird Red-faced	*Urocolius indicus*			1		1			
Black-throated Canary	*Crithagra atrogularis*			1	1			1	
Black-faced Waxbill	*Estrilda erythronotos*						1		
Spotted flycatcher	*Muscicapa striata*			1					
Wattled Starling	*Creatophora cinerea*			1					
Familiar Chat	*Cercomela familiaris*							1	
Lark Eastern Clapper	*Mirafra fasciolata*			1	1				
Lesser honeyguide	*Indicator minor*								

Appendix 2. Specialist CV.

CURRICULUM VITAE:

Gerhard Botha

Name:	:	Gerhardus Alfred Botha
Date of Birth	:	11 April 1986
Identity Number	:	860411 5136 088
Postal Address	:	PO Box 12500 Brandhof 9324
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Cell Phone Number	:	084 207 3454
Email Address	:	gabotha11@gmail.com
Profession/Specialisation	:	Ecological and Biodiversity Consultant
Nationality:	:	South African
Years Experience:	:	8
Bilingualism	:	Very good – English and Afrikaans

Professional Profile:

Gerhard is a Managing Director of Nkurenkuru Ecology and Biodiversity (Pty) Ltd. He has a BSc Honours degree in Botany from the University of the Free State Province and is currently completing a MSc Degree in Botany. He began working as an environmental specialist in 2010 and has since gained extensive experience in conducting ecological and biodiversity assessments in various development field, especially in the fields of conventional as well as renewable energy generation, mining and infrastructure development. Gerhard is a registered Professional Natural Scientist (Pr. Sci. Nat.)

Key Responsibilities:

Specific responsibilities as an Ecological and Biodiversity Specialist include, inter alia, professional execution of specialist consulting services (including flora, wetland and fauna studies, where required), impact assessment reporting, walk through surveys/ground-truthing to inform final design, compilation of management plans, compliance monitoring and audit reporting, in-house ecological awareness training to on-site personnel, and the development of project proposals for procuring new work/projects.

Skills Base and Core Competencies

- Research Project Management
- Botanical researcher in projects involving the description of terrestrial and coastal ecosystems.
- Broad expertise in the ecology and conservation of grasslands, savannahs, karroid wetland, and aquatic ecosystems.
- Ecological and Biodiversity assessments for developmental purposes (BAR, EIA), with extensive knowledge and experience in the renewable energy field (Refer to Work Experiences and References)
- Over 3 years of avifaunal monitoring and assessment experience.
- Mapping and Infield delineation of wetlands, riparian zones and aquatic habitats (according to methods stipulated by DWA, 2008) within various South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Gauteng and Northern Cape Province for inventory and management purposes.
- Wetland and aquatic buffer allocations according to industry best practice guidelines.
- Working knowledge of environmental planning policies, regulatory frameworks, and legislation
- Identification and assessment of potential environmental impacts and benefits.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functions) and ecological health/integrity.
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to execution
- Qualitative and Quantitative Research
- Experienced in field research and monitoring
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa and include a number of projects located in sensitive and ecological unique regions.

Education and Professional Status

Degrees:

- *2015:* Currently completing a M.Sc. degree in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2009:* B.Sc. Hons in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2008:* B.Sc. in Zoology and Botany, University of the Free State, University of the Free State, Bloemfontein, RSA.

Courses:

- *2013*: Wetland Management (ecology, hydrology, biodiversity, and delineation) – University of the Free State accredited course.
- *2014*: Introduction to GIS and GPS (Code: GISA 1500S) – University of the Free State accredited course.

Professional Society Affiliations:

- The South African Council of Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400502/14 (Botany and Ecology).

Employment History

- December 2017 – Current: Nkurenkuru Ecology and Biodiversity (Pty) Ltd

- 2016 – November 2017: ECO-CARE Consultancy
- *2015 - 2016*: Ecologist, Savannah Environmental (Pty) Ltd
- *2013 – 2014*: Working as ecologist on a freelance basis, involved in part-time and contractual positions for the following companies
    - Enviroworks (Pty) Ltd
    - GreenMined (Pty) Ltd
    - Eco-Care Consultancy (Pty) Ltd
    - Enviro-Niche Consulting (Pty) Ltd
    - Savannah Environmental (Pty) Ltd
    - Esicongweni Environmental Services (EES) cc
- *2010 - 2012*: Enviroworks (Pty) Ltd

Publications

Publications:

- Botha, G.A. & Du Preez, P.J. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. S. *Afr. J. Bot*., **98**: 172-173.

Congress papers/posters/presentations:

- Botha, G.A. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. 41st Annual Congress of South African Association of Botanists (SAAB). Tshipise, 11-15 Jan. 2015.
- Botha, G.A. 2014. A description of the vegetation of the Nxamasere floodplain, Okavango Delta, Botswana. 10st Annual University of Johannesburg (UJ) Postgraduate Botany Symposium. Johannesburg, 28 Oct. 2014.

Other

- Guest speaker at IAIAsa Free State Branch Event (29 March 2017)
- Guest speaker at the University of the Free State Province: Department of Plant Sciences (3 March 2017):

References:

- Christine Fouché
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  University of the Free State
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Appendix 3. Specialist's Work Experience and References

WORK EXPERIENCES

&

References

Gerhard Botha

ECOLOGICAL RELATED STUDIES AND SURVEYS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Ecological Assessment (Basic Assessment)	Moeding Solar
2019	Expansion of the Raumix Aliwal North Quarry, Eastern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	GreenMined
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Faunal and Flora Rescue and Protection Plan	Zevobuzz
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Zevobuzz
2018	Proposed Kruisvallei Hydroelectric Power Generation Scheme in the Ash River, Free State Province	Ecological Assessment (Basic Assessment)	Zevobuzz
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Ecological Assessment (Basic Assessment)	Eskom
2018	Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province	Ecological Comments Letter	Savannah Environmental
2018	Iziduli Emoyeni Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Emoyeni Wid Farm Renewable Energy

2018	Msenge Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Amakhala Emoyeni Renewable Energy
2017	H2 Energy Power Station near Kwamhlanga, Mpumalanga Province	Ecological Assessment (Scoping and EIA phase assessments)	Eskom
2017	Karusa Wind Farm (Phase 1 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	Soetwater Wind Farm (Phase 2 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Ecological Assessment	Savannah Environmental
2016 - 2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Ecological Assessment (Scoping and EIA phase assessments)	Cresco
2016	Buffels Solar 2 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	Buffels Solar 1 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	132kV Power Line and On-Site Substation for the Authorised Golden Valley II Wind Energy Facility near Bedford, Eastern Cape Province	Ecological Assessment (Basic Assessment)	Terra Wind Energy
2016	Kalahari CSP Facility: 132kV Ferrum–Kalahari–UNTU & 132kV Kathu IPP–Kathu 1 Overhead Power Lines, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Kalahari CSP Facility: Access Roads, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Karoshoek Solar Valley Development – Additional CSP Facility including tower infrastructure associated with authorised CSP Site 2 near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 7 and 8 Facilities near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 9 Facility near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Lehae Training Academy and Fire Station, Gauteng Province	Ecological Assessment	Savannah Environmental
2016	Metal Industrial Cluster and Associated Infrastructure near Kuruman, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Northern Cape Department of Economic Development and Tourism
2016	Semonkong Wind Energy Facility near Semonkong, Maseru District, Lesotho	Ecological Pre-Feasibility Study	Savannah Environmental
2015 - 2016	Orkney Solar PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015 - 2016	Woodhouse 1 and Woodhouse 2 PV Facilities near Vryburg, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy

2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Expansion of the existing Komsberg Main Transmission Substation near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Proposed Karusa Facility Substation and Ancillaries near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Eskom Karusa Switching Station and 132kV Double Circuit Overhead Power Line near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Karusa Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Facility Substation, 132kV Overhead Power Line and Ancillaries, near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Soetwater Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Expansion of the existing Scottburgh quarry near Amandawe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2015	Expansion of the existing AFRIMAT quarry near Hluhluwe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2014	Tshepong 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Transalloys circulating fluidised bed power station near Emalahleni, Mpumalanga Province	Ecological Assessment (for EIA)	Trans-Alloys
2014	Umbani circulating fluidised bed power station near Kriel, Mpumalanga Province	Ecological Assessment (Scoping and EIA)	Eskom

2014	Gihon 75MW Solar Farm: Bela-Bela, Limpopo Province	Ecological Assessment (for EIA)	NETWORX Renewables
2014	Steelpoort Integration Project & Steelpoort to Wolwekraal 400kV Power Line	Fauna and Flora Pre-Construction Walk-Through Assessment	Eskom
2014	Audit of protected *Acacia erioloba* trees within the Assmang Wrenchville housing development footprint area	Botanical Audit	Eco-Care Consultancy
2014	Rehabilitation of the N1 National Road between Sydenham and Glen Lyon	Peer review of the ecological report	EKO Environmental
2014	Rehabilitation of the N6 National Road between Onze Rust and Bloemfontein	Peer review of the ecological report	EKO Environmental
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks
2011	Rocks Farm chicken broiler houses	Botanical Assessment (for EIA)	EnviroWorks
2011	Botshabelo 132 kV line	Ecological Assessment (for EIA)	CENTLEC
2011	De Aar Freight Transport Hub	Ecological Scoping and Feasibility Study	EnviroWorks
2011	The proposed establishment of the Tugela Ridge Eco Estate on the farm Kruisfontein, Bergville	Ecological Assessment (for EIA)	EnviroWorks
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Vegetation Rehabilitation Plan for illegally cleared areas	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Invasive Plant Management Plan	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Protected and Endangered Species Walk-Through Survey	NEOTEL
2011	Optic Fibre Infrastructure Network, Swartland Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2011	Optic Fibre Infrastructure Network, City of Cape Town Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2010	Construction of an icon at the southernmost tip of Africa, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	New boardwalk from Suiderstrand Gravel Road to Rasperpunt, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	Farm development for academic purposes (Maluti FET College) on the Farm Rosedale 107, Harrismith	Ecological Assessment (Screening and Feasibility Study)	Agri Development Solutions
2010	Basic Assessment: Barcelona 88/11kV substation and 88kV loop-in lines	Botanical Assessment (for EIA)	Eskom Distribution
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks

WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
In progress	Steynsrus PV 1 & 2 Solar Energy Facilities near Steynsrus, Free State Province	Wetland Assessment	Cronimet Mining Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Wetland Assessment (Basic Assessment)	Moeding Solar
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Wetland Assessment (Basic Assessment	Zevobuzz

2017	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Surface Hydrological Assessment (Basic Assessment)	Eskom
2017	Expansion of the Elandspruit Quarry near Ladysmith, KwaZulu-Natal Province	Wetland Assessment	Raumix
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Aquatic Assessment & Flood Plain Delineation	Savannah Environmental
2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Surface Hydrological Assessment (EIA phase)	Cresco
2016	Wolmaransstad Municipality 75MW PV Solar Energy Facility in the North West Province	Wetland Assessment (Basic Assessment)	BlueWave Capital
2016	BlueWave 75MW PV Plant near Welkom Free State Province	Wetland Delineation	BlueWave Capital
2016	Harmony Solar Energy Facilities: Amendment of Pipeline and Overhead Power Line Route	Wetland Assessment (Basic Assessment)	BBEnergy

AVIFAUNAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Avifauna Assessment (Basic Assessment)	Moeding Solar
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Avifauna Assessment (Basic Assessment)	Eskom
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Avifauna Assessment (Basic Assessment)	Eskom
2016	TEWA Solar 1 Facility, east of Upington, Northern Cape Province	Wetland Assessment (Basic Assessment	Tewa Isitha Solar 1
2016	TEWA Solar 2 Facility, east of Upington, Northern Cape Province	Wetland Assessment	Tewa Isitha Solar 2

ENVIRONMENTAL IMPACT ASSESSMENT

- Barcelona 88/11kV substation and 88kV loop-in lines – BA (for Eskom).
- Thabong Bulk 132kV sub-transmission inter-connector line – EIA (for Eskom).
- Groenwater 45 000 unit chicken broiler farm – BA (for Areemeng Mmogo Cooperative).
- Optic Fibre Infrastructure Network, City of Cape Town Municipality – BA (for Dark Fibre Africa (Pty) Ltd).
- Optic Fibre Infrastructure Network, Swartland Municipality – BA (for Dark Fibre Africa).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – EMP (for Eskom).
- Lower Kruisvallei Hydroelectric Power Scheme (Ash river) – EIA (for Kruisvallei Hydro (Pty) Ltd).

- Construction of egg hatchery and associated infrastructure – BA (For Supreme Poultry).
- Construction of the Klipplaatdrif flow gauging (Vaal river) – EMP (DWAF).

ENVIRONMENTAL COMPLIANCE AUDITING AND ECO

- National long haul optic fibre infrastructure network project, Bloemfontein to Laingsburg – ECO (for Enviroworks (Pty) Ltd.).
- National long haul optic fibre infrastructure network project, Wolmaransstad to Klerksdorp – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the Vredefort/Nooitgedacht 11kV power line – ECO (for Enviroworks (Pty) Ltd.).
- Mining of Dolerite (Stone Aggregate) by Raumix (Pty) Ltd. on a portion of Portion 0 of the farm Hillside 2830, Bloemfontein – ECO (for GreenMined Environmental (Pty) Ltd.).
- Construction of an Egg Production Facility by Bainsvlei Poultry (Pty) Ltd on Portions 9 & 10 of the farm, Mooivlakte, Bloemfontein – ECO (for Enviro-Niche Consulting (Pty) Ltd.).
- Environmental compliance audit and botanical account of Afrisam's premises in Bloemfontein – Environmental Compliance Auditing (for Enviroworks (Pty) Ltd.).

OTHER PROJECTS:

- Keeping and breeding of lions (*Panthera leo*) on the farm Maxico 135, Ficksburg – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of lions (*Panthera leo*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of wild dogs (*Lycaon pictus*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Existing underground and aboveground fuel storage tanks, TWK AGRI: Pongola – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Erf 171, TWK AGRI: Amsterdam – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 14 000 L of fuel (diesel) aboveground on Erf 32, TWK AGRI: Carolina – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 23 000 L of fuel (diesel) above ground on Portion 10 of the Farm Oude Bosch, Humansdorp – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 16 000 L of fuel (diesel) aboveground at Panbult Depot – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks, TWK AGRI: Mechanisation and Engineering, Piet Retief – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Portion 38 of the Farm Lothair, TWK AGRI: Lothair –

Environmental Management Plan (for TWK Agricultural Ltd).