GEOHYDROLOGY

GEOTECHNICAL

ENVIRONMENTAL

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Terrestrial Biodiversity, Plant and Animal Species Impact Assessment Report

A TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT (INCLUDING PLANT AND ANIMAL SPECIES ASSESSMENT) FOR THE PROPOSED POWER LINE FOR THE SONVANGER PHOTOVOLTAIC SOLAR POWER PLANT NEAR THEUNISSEN, FREE STATE PROVINCE

July 2021

Prepared for: ENVIRONAMICS CC

Compiled by Dr BJ Henning

Document version 1.0 – Draft

AGES
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A TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT (INCLUDING PLANT AND ANIMAL SPECIES ASSESSMENT) PROPOSED POWER LINE FOR THE SONVANGER PHOTOVOLTAIC SOLAR POWER PLANT NEAR THEUNISSEN, FREE STATE PROVINCE

July 2021

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M.Sc. Botany - Soil Science related

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Curriculum Vitae

CURRICULUM VITAE

B J Henning

PhD Plant Ecology

PERSONAL DETAILS

Name:	BAREND JOHANNES HENNING
Date of Birth:	1976-09-06
Profession/Specialization:	Senior Ecologist
Years with Firm:	6 years (previously 2006-2012 & since May 2020)
Nationality:	South African
Years' experience:	15 years

QUALIFICATIONS

University attended:	University of Pretoria, Pretoria (1995- 2002) PhD Plant Ecology, MSc (Botany), BSc (Hons.), BSc

COURSES

Advanced Wetland Course (UP CE, 2010)

Wetland Rehabilitation Course (UFS, 2015)

Course on wetland offsets (SANBI)

KEY QUALIFICATIONS AND EXPERIENCE

- Senior Ecologist / Soil Science Specialist for Ages Limpopo since September 2006 to 2012 and again since May 2020 involved in the following aspects:
    - Agricultural potential and land capability studies of soils on farms. (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)
    - Spatial Development Frameworks.
    - Strategic Development Area Frameworks for local municipalities
    - Vegetation surveys, sensitivity, and zoning analysis of development sites, including eco-estates, mines, residential developments, shopping centres, roads, water supply and other related infrastructure etc (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160;)
    - Faunal analysis and scoping reports (Reference: Mr Johan Botha, AGES Limpopo; 0152911577, Mr Herman Gildenhuys, Exigo; 0127512160)

  - Avifauna studies related to solar plant and power line connection developments.
  - Wetland delineations and functional capacity assessments (completed advanced wetland course of the Continued Education Department, University of Pretoria 2010 as well as Wetland rehabilitation course of the University of the Free State).
  - Wildlife Management Plans and habitat assessment for rare and endangered game species.
  - GIS related functions.

- Senior Ecologist for Exigo (previously AGES Gauteng) November 2012 to April 2020. Involved in all the abovementioned aspects.
- Environmental Consultant for Envirodel Wildlife & Ecological Services cc and Dubel Integrated Environmental Services, Polokwane 2004 - 2006. Involved in the following aspects:
  - Wildlife management plans for game farms /reserves throughout the Limpopo Province
  - Environmental impact assessments (vegetation surveys and faunal scoping reports), habitat suitability analysis and report compilation.
  - Coordinating and performing grass monitoring surveys for the Limpopo Tourism and Parks Board
  - Soil potential studies.
- Environmental Consultant for Ficus – pro Environmental Services cc., Modimolle 2004 / 5. Involved mostly in fieldwork, report compilation or impact studies. Reference: Mr. R. Venter (0147173378)
- Subconsultant for AGES (Africa Geo-Environmental Services 2005-2006. Vegetation surveys and sensitivity zoning and analyses. Mr Johan Botha (0836449957)
- Eco-Agent environmental services cc, Pretoria 2002 - 2004. Involved in environmental impact studies. Prof G. J. Bredenkamp (0825767046), University of Pretoria.
- Enviroguard environmental services cc, Heidelberg 2002 - 2004. Involved in environmental impact studies. Prof L. R Brown (0825767046).
- GIS related aspects for all the above-mentioned aspects on projects

POSITION AND DUTIES

Employed as Senior Ecological Specialist. Main duties and responsibilities include:

- Compilation of project proposals.
- Conducting specialist assessments
    - Ecological assessments
    - Soils and Land use potential studies.
    - Wetland assessments.
    - Wetland rehabilitation plans.
    - Ecological & wetland monitoring.
    - Biodiversity Action & Management Plans.
    - Agricultural assessments.
    - Avifauna assessments.
    - Wildlife Management Plans and assessments.
    - Rehabilitation Strategy & Implementation Programmes (RSIPs)
- Liaison with clients.
- GIS and map compilation.
- Project admin and management.
- Integration and interaction with the environmental consultants.
- Travelling.
- Any ad hoc duties that may be given by immediate manager.

Declaration

I, DR BJ Henning declare that -

- I act as the independent specialist.
- I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this project, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 43310 Government Notice R. 320, Plant and Animal Species Protocols, regulations and any guidelines that have relevance to the activity.
- I will comply with the Act, regulations and all other applicable legislation.
- I will consider, to the extent possible, the matters listed in Regulation 18 of the NEMA EIA Regulations.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the project proponent and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the project; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent.
- All the particulars furnished by me in this document are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 320 and is punishable in terms of section 24F of the Act.

_____

SIGNATURE OF SPECIALIST

JULY 2021

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NOTATIONS AND TERMS

Biota: living things; plants, animals, bacteria

Bottomland: the lowlands along streams and rivers, on alluvial (river deposited) soil.

Connectivity: in this context, referring to either the upstream-downstream or lateral (between the channel and the adjacent floodplain) connectivity of a drainage line. Upstream-downstream connectivity is an important consideration for the movement of sediment as well as migratory aquatic biota. Lateral connectivity is important for the floodplain species dependent on the wetting and nutrients associated with overbank flooding.

Endorheic: closed drainage e.g., a pan.

Floristic: of flora (plants).

Floodplain: wetland inundated when a river overtops its banks during flood events resulting in the wetland soils being saturated for extended periods of time.

Gley: soil material that has developed under anaerobic conditions because of prolonged saturation with water. Grey and sometimes blue or green colours predominate but **mottles** (yellow, red, brown, and black) may be present and indicate localised areas of better aeration.

Groundwater: subsurface water in the zone in which permeable rocks, and often the overlying soil, are saturated under pressure equal to or greater than atmospheric.

Horizon: see soil horizons.

Hydrophyte: any plant that grows in water or on a substratum that is at least periodically deficient in oxygen because of soil saturation or flooding; plants typically found in wet habitats.

Hydro-geomorphic: refers to the water source and geology forms.

Hydrology is defined in this context as the distribution and movement of water through a wetland and its soils.

Geomorphology is defined in this context as the distribution and retention patterns of sediment within the wetland.

Infilling: dumping of soil or solid waste onto the wetland surface. Infilling generally has a very high and permanent impact on wetland functioning and is like drainage in that the upper soil layers are rendered less wet, usually so much so that the area no longer functions as a wetland.

Mottles: soils with variegated colour patters are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.

Organic soil material: soil material with a high abundance of un-decomposed plant material and humus.

Palustrine (wetland): all non-tidal wetlands dominated by persistent emergent plants (e.g., reeds) emergent mosses or lichens, or shrubs or trees (see Cowardin *et al.*, 1979).

Perched water table: the upper limit of a zone of saturation in soil, separated by a relatively impermeable unsaturated zone from the main body of groundwater.

Permanently wet soil: soil which is flooded or waterlogged to the soil surface throughout the year, in

most years.

Riparian: the area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as **riparian wetlands**. However, some riparian areas are not wetlands (e.g., an area where alluvium is periodically deposited by a stream during floods, but which is well drained).

Roughness coefficient: an index of the roughness of a surface; a reflection of the frictional resistance offered by the surface to water flow.

Runoff: total water yield from a catchment including surface and subsurface flow.

Seasonally wet soil: soil which is flooded or waterlogged to the soil surface for extended periods (>1 month) during the wet season but is predominantly dry during the dry season.

Sedges: grass-like plants belonging to the family *Cyperaceae*, sometimes referred to as nutgrasses. Papyrus is a member of this family.

Soil drainage classes: describe the soil moisture conditions as determined by the capacity of the soil and the site for removing excess water. The classes range from very well drained, where excess water is removed very quickly, to very poorly drained, where excess water is removed very slowly. Wetlands include all soils in the very poorly drained and poorly drained classes, and some soils in the somewhat poorly drained class. These three classes are roughly equivalent to the permanent, seasonal and temporary classes.

Soil horizons: layers of soil that have uniform characteristics and have developed through pedogenic processes; they are bound by air, hard rock or other horizons (i.e., soil material that has different characteristics).

Soil profile: the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991).

Soil saturation: the soil is considered saturated if the water table or **capillary fringe** reaches the soil surface (Soil Survey Staff, 1992).

Temporarily wet soil: the soil close to the soil surface (i.e., within 50 cm) is wet for periods > 2 weeks during the wet season in most years. However, it is seldom flooded or saturated at the surface for longer than a month.

Terrain unit classes: areas of the land surface with homogenous form and slope. Terrain may be seen as being made up of all or some of the following units: crest (1), scarp (2), midslope (3), footslope (4) and valley bottom (5).

Transpiration: the transfer of water from plants into the atmosphere as water vapour

Unchanneled valley bottom: linear fluvial, net depositional valley bottom surfaces which do not have a channel. The valley floor is a depositional environment composed of fluvial or colluvial deposited sediment. These systems tend to be found in the upper catchment areas.

Vegetation is defined in this context as the vegetation structural and compositional state.

Water regime: when and for how long the soil is flooded or saturated.

Water Quality largely self-explanatory and reflecting the changes in quality because of changes in

land use or as a direct result of activities within the wetland itself that could lead to changes in the quality of the water flowing through and within the wetland.

Waterlogged: soil or land saturated with water long enough for anaerobic conditions to develop.

Wetland: land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

Wetland catchment: the area up-slope of the wetland from which water flows into the wetland and including the wetland itself.

Wetland delineation: The determination and marking of the boundary of a wetland on a map.

LIST OF ABBREVIATIONS

Abbreviation	Description
ARC	Agricultural Research Council
C-Plan	Conservation Plan
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DME	Department of Minerals and Energy Affairs
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPR	Environmental Management Programme Report
ENPAT	Environmental Potential Atlas
GIS	Geographic Information Systems
GPS	Geographical Positioning System
HGM	Hydro-Geomorphic
HFI	Hydrological Function and Importance
IHI	Index of Habitat Integrity
IUCN	World Conservation Union
MAE	Mean Annual Evaporation
MAMSL	Meter Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
NEMA	National Environmental Management Act
PES	Present Ecological State
PESC	Present Ecological Status Class
PQ4	Priority Quaternary Catchment
QDS	Quarter Degree Square
SADC	Southern African Development Community
SANBI	South African National Biodiversity Institute
WMA	Water Management Area
WHO	World Health Organisation

1 ASSIGNMENT

AGES Limpopo (Pty) Ltd was appointed by ENVIRONAMICS CC to conduct a terrestrial biodiversity, plant species and animal species impact assessment for the proposed development of a 132kV single-circuit power line to enable the connection of the authorised Sonvanger Photovoltaic Solar Power Plant (DFFE ref.: 14/12/16/3/3/2/672) to the national grid network. This will enable the evacuation of the generated solar electricity. A 200m wide and 22km long grid connection corridor is being assessed for the placement of the power line route. The power line is proposed to connect into the existing Oryx-Joel 132kV Line. A service road associated with the power line is also proposed to be developed.

The Species Environmental Impact Assessments Guideline has been developed in support of the Terrestrial Biodiversity, Plant and Animal Species protocols that were gazetted 30th October 2020 (Government Notice number 1150). This guideline provides details for implementing relevant species protocols and is available for use to plant and animal specialists, environmental assessment practitioners and Competent Authorities.

According to the national web-based environmental screening tool in terms of National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998), the site has the following sensitivities:

- Terrestrial Biodiversity: Very High Sensitivity (Figure 1).
- Animal Species Theme: Medium Sensitivity (Figure 2).
- Plant Species Theme: Low Sensitivity (Figure 3).

A pre-screening site visit was therefore conducted to determine if the assessment was accurate and if the studies recommended should be conducted. After the site visit the following was concluded:

- The site has a HIGH Sensitivity from a terrestrial biodiversity perspective due to the presence of indigenous grassland and wetlands.
- The site has a Medium Sensitivity from an Animal Species Theme Perspective due to the presence of natural fauna habitats.
- The site has a Medium Sensitivity from a Plant Species Theme Perspective due to the presence of indigenous grassland with protected tree species.

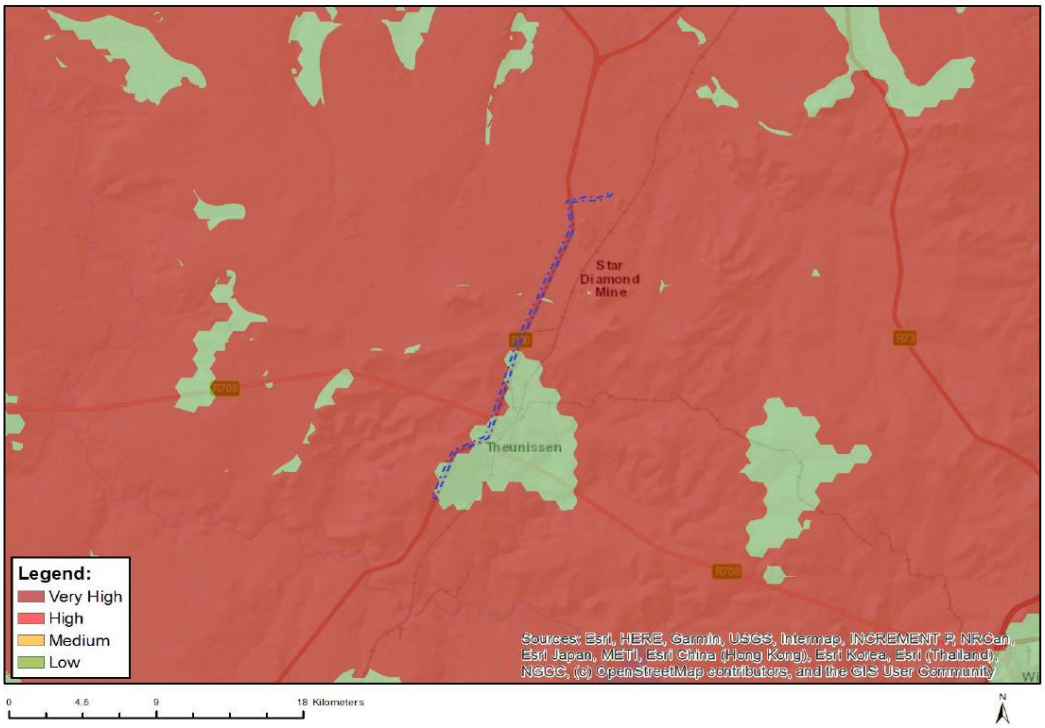
After the assessment, it was concluded that a detailed terrestrial biodiversity, plant species theme and animal species theme assessment should be conducted.

This report will include a detailed impact assessment of the proposed development site on the biodiversity of the site. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in compliance with Gazette No. 43310 Government Notice R320.

The assignment is interpreted as follows: Compile a terrestrial biodiversity assessment on the

flora (vegetation units), fauna and general ecology of the site and determine the potential impacts of the proposed development on the fauna and flora of the area as well as any impacts on the wetlands and proposed mitigation measures. The study will be done according to guidelines and criteria set by Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs and the regulations recently gazetted for biodiversity studies as well as animal and plant species protocols.

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



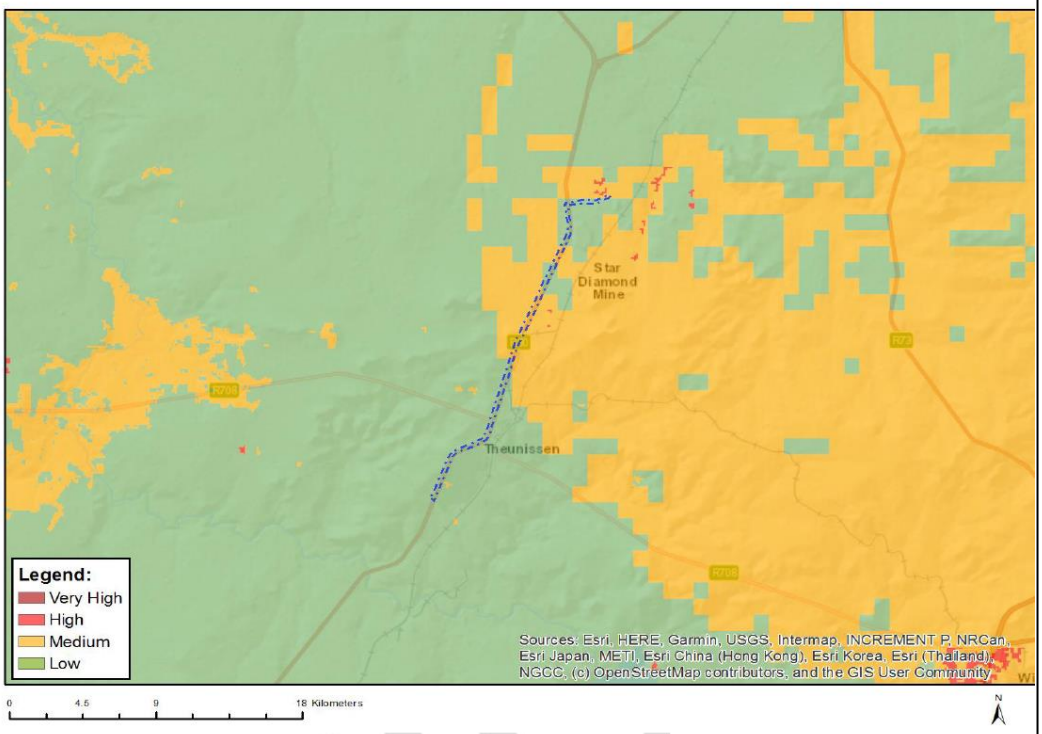
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	Critical Biodiversity Area 1
Very High	Critical Biodiversity Area 2
Very High	Ecological Support Area 1
Very High	Ecological Support Area 2
Very High	Focus Areas for land-based protected areas expansion
Very High	Endangered ecosystem
Very High	South African Protected Areas

Figure 1. Terrestrial Biodiversity Sensitivity as obtained from the EIA screening tool for the site

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

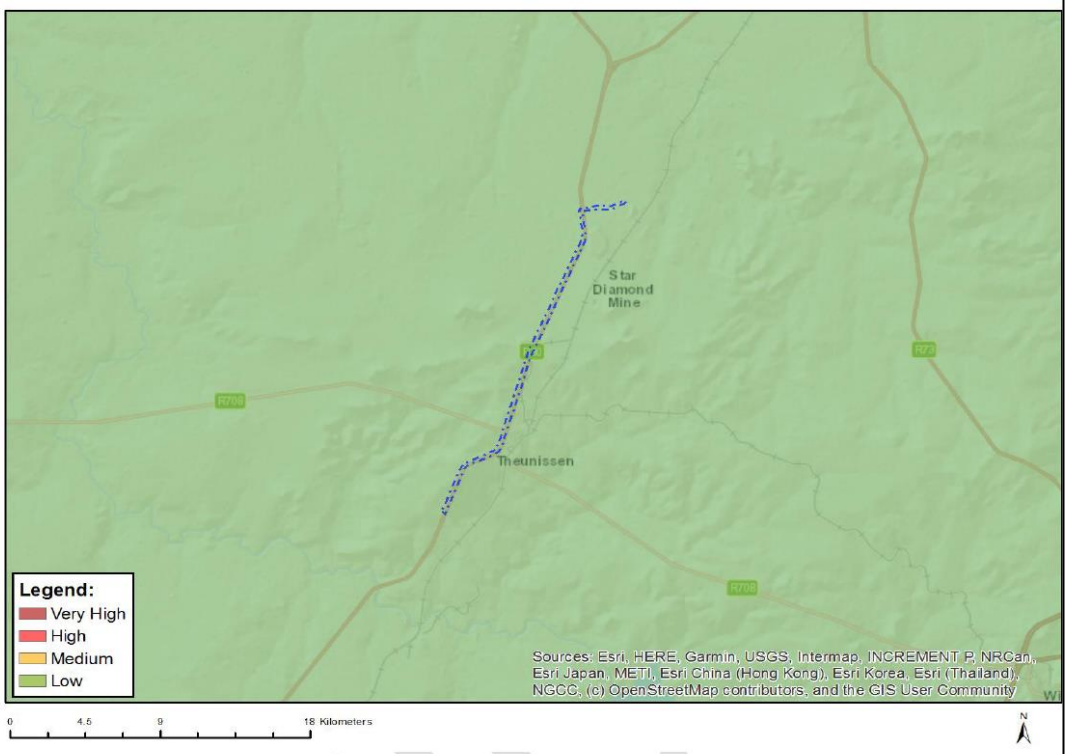
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Medium	Mammalia-Hydrictis maculicollis

Figure 2. Animal Species Theme Sensitivity as obtained from the EIA screening tool for the site

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



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Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

Figure 3. Plant Species Theme Sensitivity as obtained from the EIA screening tool for the site.

1.1 INFORMATION SOURCES

- All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to the ecological components in the study area.
- Requirements regarding the fauna and flora survey as regulated by the newest terrestrial biodiversity, plant species theme and animal species theme protocols (National Environmental Management Act No. 107 of 1998 - Gazette No. 43310 Government Notice R. 320).
- Requirements regarding the fauna and flora survey as requested by Free State

Department: Economic, Small Business Development, Tourism and Environmental Affairs.

- Legislation pertaining to the fauna and flora study as relevant.
- Red data species list from the South African National Biodiversity Institute (SANBI), including the species data for the terrestrial biodiversity and the red listed species potentially occurring on site was obtained from the EIA screening tool prior to the site visit.
- Information on plant and animal species recorded for the various Quarter Degree Squares was extracted from the SABIF/SIBIS database hosted by SANBI and the faunal databases hosted by the Animal Demography Unit (ADU). This includes a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has not been well sampled in the past.
- 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.
- Critical Biodiversity Areas were obtained from the various coverages produced by the Free State C-Plan (2015).

1.2 REGULATIONS GOVERNING THIS REPORT

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Gazette No. 43310 Government Notice R. 320

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 43310 Government Notice R. 320. Specialist reports includes a list of requirements to be included in a specialist report for a Terrestrial Biodiversity, Plant Species and Animal Species Assessment

1. A specialist report or a 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.
    b. A declaration that the specialist is independent in a form as may be specified by the competent authority.
    c. An indication of the scope of, and purpose for which, the report was prepared.
    d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment.

e. A description of the methodology adopted in preparing the report or carrying out the specialized process.

f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure.

g. An identification of any areas to be avoided, including buffers.

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.

i. A description of any assumptions made and any uncertainties or gaps in knowledge.

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.

k. any mitigation measures for inclusion in the EMPr.

l. any conditions for inclusion in the environmental authorisation.

m. any monitoring requirements for inclusion in the EMPr or environmental authorisation.

n. Plant species protocols:

    i.

o. a reasoned opinion –

    i. As to whether the proposed activity or portions thereof should be authorised and

    ii. If the opinion is that the proposed activity 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.

p. A description of any consultation process that was undertaken while preparing the specialist report.

q. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

r. Any other information requested by the competent authority.

This Act also embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

1.2.2 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

This Act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

1.2.3 National Environmental Management Biodiversity Act (Act 10 0f 2004) (NEMBA)

The following aspects of the NEMBA (2004) are important to consider in the compilation of an ecological report. It:

- Lists ecosystems that are threatened or in need of national protection.
- Links to Integrated Environmental Management processes.
- Must be considered in EMPs and IDPs.
- The Minister may make regulations to reduce the threats to listed ecosystems.

1.2.4 The National Forest Act (Act 84 of 1998) (NFA)

In terms of section 15(1) of the National Forests Act, 1998, no person may cut, disturb, damage, or destroy any protected tree; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister of Agriculture, Forestry and Fisheries.

1.2.5 Free State Nature Conservation Ordinance (1969)

This Act deals with the following:

- To provide for the sustainable utilisation and protection of biodiversity within the Free State Province.
- To provide for professional hunting.
- To provide for the preservation of caves and cave formations.
- To provide for the establishment of zoos and similar institutions.
- To provide for the appointment of nature conservators.
- To provide for the issuing of permits and other authorisations.
- To provide for offences and penalties for contravention of the Act.
- To implement the provisions of the Ordinance and to provide for matters connected therewith.

1.3 TERMS OF REFERENCE

1.3.1 Objectives

1. The primary aim of this report is to investigate options for enhancing and / or maintaining biodiversity to mitigate the impact of the development and related infrastructure with the overall objective of preventing further loss of biodiversity. The product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
    a. Protection of native vegetation restored elsewhere in return for unavoidable clearing.
    b. Minimisation of habitat fragmentation.
    c. Minimisation of any threats to the native flora and fauna and their habitats during the construction and operational phases of the developments and.
    d. Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
2. To produce clear and agreed species and habitat priorities for conservation actions. This includes the following:
    i. Determine the ecological impacts and actions the development will have on the biodiversity on a species and habitat level.
    ii. Conduct a risk analyses of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area.
    iii. Protection and enhancement of vegetation / habitats of high conservation value.
    iv. The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities.
    v. The retention and / or creation of vegetation links, wildlife corridors and vegetation buffers wherever possible, subject to the appropriate bush fire risk management; and
    vi. The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.
3. Provide recommendations on the ecological mitigation measures to be implemented by the developer and the way forward.

1.3.2 Scope

1. Conduct a field study to determine the state of the vegetation on site:
    i. After studying the aerial photograph determine the previous state of the vegetation compared to the current state of the vegetation on site.

ii. Conduct a site visit and list the plant species (trees, shrubs, grasses, succulents and other herbaceous species of special interest) present for plant communities still present after construction.

iii. Identify potential red data plant species, possible encroacher species, medicinal plants of value and exotic plant species.

2. Determine the ecological impact the development will have on the fauna and flora of the site and conduct an impact rating assessment.

3. Fauna scoping
    a. List the potential fauna (mammal species, red data birds, reptiles, amphibians, invertebrates) present linked to the specific potential habitats that occur as identified in the vegetation survey.
    b. Analyse the data and identify potential red data fauna species, as well as other endemic or protected species of importance.
    c. Indicate species mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna of the area.

4. General
    a. Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, flood lines etc.
    b. Identify problem areas in need of special treatment or management, e.g., bush encroachment, erosion, degraded areas, reclamation areas.
    c. Make recommendations, impact ratings and risk assessments for each specific impact.

1.3.3 Limitations and assumptions

- Maintaining due cognisance of the integrity and accuracy of the ecological survey, it should be stated that the ecological resources identified during the study do not necessarily represent all the ecological resources present within the power line corridor.
- To obtain a comprehensive understanding of the dynamics of communities and the status of endemic, rare or threatened species in an area, ecological studies should ideally be replicated over several seasons and over a few years. However, due to project time constraints such long-term studies are not feasible.
- Most threatened plant species are extremely seasonal and only flower during specific periods of the year,
- Most threatened faunal species are extremely secretive and difficult to survey even during thorough field surveys conducted over several seasons.

- The detailed surveys focused on the proposed development footprint of the power line. Although surveys were conducted in other areas of the site during the pre-screening and siting exercise, these areas were identified as sensitive and unsuitable for the development, and therefore no further surveys in these areas were considered necessary.

Thus, even though it might be assumed that survey findings are representative of the ecosystem of the site for the development activities, it should be stated that the possibility exists that individual plants species might have been missed due to the nature of the terrain and size of the study area/powerline corridor. Therefore, maintaining due cognisance of the integrity and accuracy of the ecological survey, it should be stated that the ecological resources identified during the study do not necessarily represent all the ecological resources present within the powerline corridor.

2 METHODS

2.1 VEGETATION AND PLANT SPECIES SURVEY

Two basic methods were used during the vegetation survey:

- Line transects were walked on the site surveyed to record the plant species present. Rare and threatened plant species and any botanically sensitive sites or habitats were searched for in the various vegetation units.
- The Braun-Blanquet survey technique to describe plant communities as ecological units was also used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area.

The site surveys were conducted on 20 July 2021. The relevance of the season (summer months) had NO impact on the outcome of the assessment. The vegetation was in a moderate condition and most species could be identified, although some species might have been missed because of the winter conditions (dormant geophytes).

2.1.1 Data recorded:

Plant names used in this report are in accordance with Arnold & De Wet (1993), except for a few newly revised species. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes, and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence as well as potential fauna habitat that might occur.

2.1.2 Red data species

A species list of the red data species previously recorded in the vicinity of the development was obtained from the EIA screening tool as well as the South African Biodiversity Institute (SANBI), South Africa as classified by the IUCN red data list categories.

2.1.3 Protected trees

A species list of the protected tree species was obtained from the Department of Forestry. These trees are listed by the NFA (Act 84 of 1998) as protected.

2.1.4 Protected plants

A list of protected and specially protected plants was obtained from the Free State Nature Conservation Ordinance.

2.1.5 Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub, and herbaceous layers.

Conservation priority of each vegetation unit was assessed by evaluating the plant species

composition in terms of the present knowledge of the vegetation of the Free State Province, as well as the vegetation type.

The following four conservation priority categories were used for each vegetation unit:

- High: Ecologically sensitive and valuable land with high species richness that should be conserved, and no development allowed.
- Medium: Land that should be conserved but on which low impact development could be considered with the provision of mitigation measures.
- Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.
- Low: Land that has little conservation value and that could be considered for development with little to no impact on the vegetation / ecosystem.

2.2 FAUNA HABITATS AND ANIMALS' SPECIES SURVEY

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats after identifying the vegetation units. Fauna observed on site, or any specific indication of species was noted as confirmed in the species lists.
- A scoping survey was then conducted by comparing the habitat types identified within the preferred habitats of species occurring in the area.
- A survey was thereafter conducted to document species occurring in the habitats on site.

2.2.1 Data recorded:

A list of all species of fauna and their status as observed on the site or that could potentially occur on the site was compiled. Notes were made of any specific sensitive or specialised habitats that occur on the site.

2.2.2 Red data species lists

A species list of the red data species of the different faunal classes was obtained from the following references:

- EIA screening tool as relevant for the project area.
- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004)
- The Atlas of the Southern African Birds - digital data on quarter degree grid data (Avian Demography Unit, University of Cape Town)
- Atlas and red data book of the frogs of South Africa, Lesotho, and Swaziland (Minter et al. 2004)

- South African Red Data Book – Reptiles and Amphibians. National Scientific Programmes Report no. 151.

2.2.3 Data processing

A comparison of the habitats (vegetation units) occurring within the power line corridor was made to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian, and insect species were compiled and mitigating measures recommended if needed.

2.3 IMPACT RATING ASSESSMENT MATRIX

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

Probability. This describes the likelihood of the impact occurring:

- Improbable: The possibility of the impact occurring is very low, due to the circumstances, design, or experience.
- Probable: There is a probability that the impact will occur to the extent that provision must be made, therefore.
- Highly Probable: It is most likely that the impact will occur at some stage of the development.
- Definite: The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

Duration. The lifetime of the impact

- Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- Medium term: The impact will last up to the end of the phases, where after it will be negated.
- Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale. The physical and spatial size of the impact

- Local: The impacted area extends only as far as the activity, e.g., footprint.
- Site: The impact could affect the whole, or a measurable portion of the above-mentioned properties.
- Regional: The impact could affect the area including the neighbouring areas.

Magnitude/ Severity. Does the impact destroy the environment or alter its function?

- Low: The impact alters the affected environment in such a way that natural processes are not affected.
- Medium: The affected environment is altered, but functions and processes continue in a modified way.
- High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance. This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

- Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
- High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute (Table 1):

Table 1. Impact rating assessment weights

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1

Aspect	Description	Weight
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	**Sum (Duration, Scale, Magnitude) x Probability**	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for the development.

The mitigation effect of each impact will be indicated without and with mitigation measures as follows:

- Can be reversed.
- Can be avoided, managed or mitigated.
- May cause irreplaceable loss of resources.

2.4 SENSITIVITY ASSESSMENT

The ecological sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity.

2.4.1 Ecological function

The ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g., wetlands) or overall preservation of biodiversity.

2.4.2 Conservation importance

Conservation importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

2.4.3 Sensitivity scale

- High – sensitive ecosystem with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or with high species diversity and usually provide suitable habitat for a few threatened or rare

species. These areas should be protected.

- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species.
- Low – Degraded and highly disturbed / transformed systems with little ecological function and which are generally very poor in species diversity.

2.5 EIA SCREENING TOOL

The significance of a site or natural feature may only become apparent when it is evaluated in terms of a broader biodiversity context. Put differently, local impacts on biodiversity may seem unimportant, but can become highly significant when interpreted beyond the immediate boundaries of a site. Even if a locality has a history of disturbance such as alien infestation, cultivation, or recurrent fires, and it does not host any plant or animal species of special concern, it may nevertheless be significant for biodiversity conservation when viewed from a landscape or even national perspective.

According to the national web-based environmental screening tool in terms of section 24(5)(h) of the NEMA, 1998 (Act No 107 of 1998) and regulation 16(1)(b)(v) of the EIA regulations, 2014, as amended, the following listed fauna and flora species occur in the project area. The surveys for the project area will focus specifically on these species according to species protocols.

Fauna:

- *Hydrictis maculicollis* (Spotted necked Otter).
    - Sensitivity: Medium.
    - Status: Near Threatened.

3 BASELINE ENVIRONMENT

3.1 LOCATION AND DESCRIPTION OF ACTIVITY

The activity entails the development of a 132kV single-circuit power line to enable the connection of the authorised Sonvanger Photovoltaic Solar Power Plant (DFFE ref.: 14/12/16/3/3/2/672) to the national grid network. This will enable the evacuation of the generated solar electricity. A 200m wide and 22km long grid connection corridor is being assessed for the placement of the power line route. The power line is proposed to connect into the existing Oryx-Joel 132kV Line. A service road associated with the power line is also proposed to be developed.

The grid connection corridor is located directly to the west of the town of Theunissen (along the R30) and falls within the Masilonyana and the Matjhabeng Local Municipalities of the Lejweleputswa District Municipality, Free State Province (refer to the attached locality map).

Various properties are affected by the grid connection corridor, which includes:

- Afrikander Oord 80 (Portions 0 & 2),
- Ebenhaeser 401 (Portions 0, 1, 2 and 3),
- Erfbloem 12 (Portions 0, 4, 5 and 6), Excelsior 147 (Portions 1, 2 and 3),
- Goedemoed 143 (Portions 0, 2 and 3),
- Grottkau 410 (Portions 0, 3 and 5),
- Karreebooms Vallei (Portions 0, 2, 5, 6, 7 and 8),
- Leeuwbult 52 (Portions 0 and 3),
- Leeuwvlei 115 (Portions 0, 1, 2 and 3),
- Mamre 566 (Portions 0, 1, 2 and 3),
- Masilo 597 (Portions 0 and 12),
- Mooi Hoek 297 (Portions 0, 1, 4 and 5),
- Silesia 409 (Portions 0, 2 and 3),
- Smaldeel 262 (Portions 0, 1, 2, 8, 20, 21, 22, 23),
- Spes Bona 290 (Portions 0 and 2),
- Theunissen 252 (Portions 0 and 2),
- Vergelegen 85 (Portions 1, 4, 5 and 7).

The planned development footprint of the powerline was carefully selected after a pre-screening site visit was conducted on the 20th of July 2021. The aerial map of the powerline corridor is presented in Figure 5.

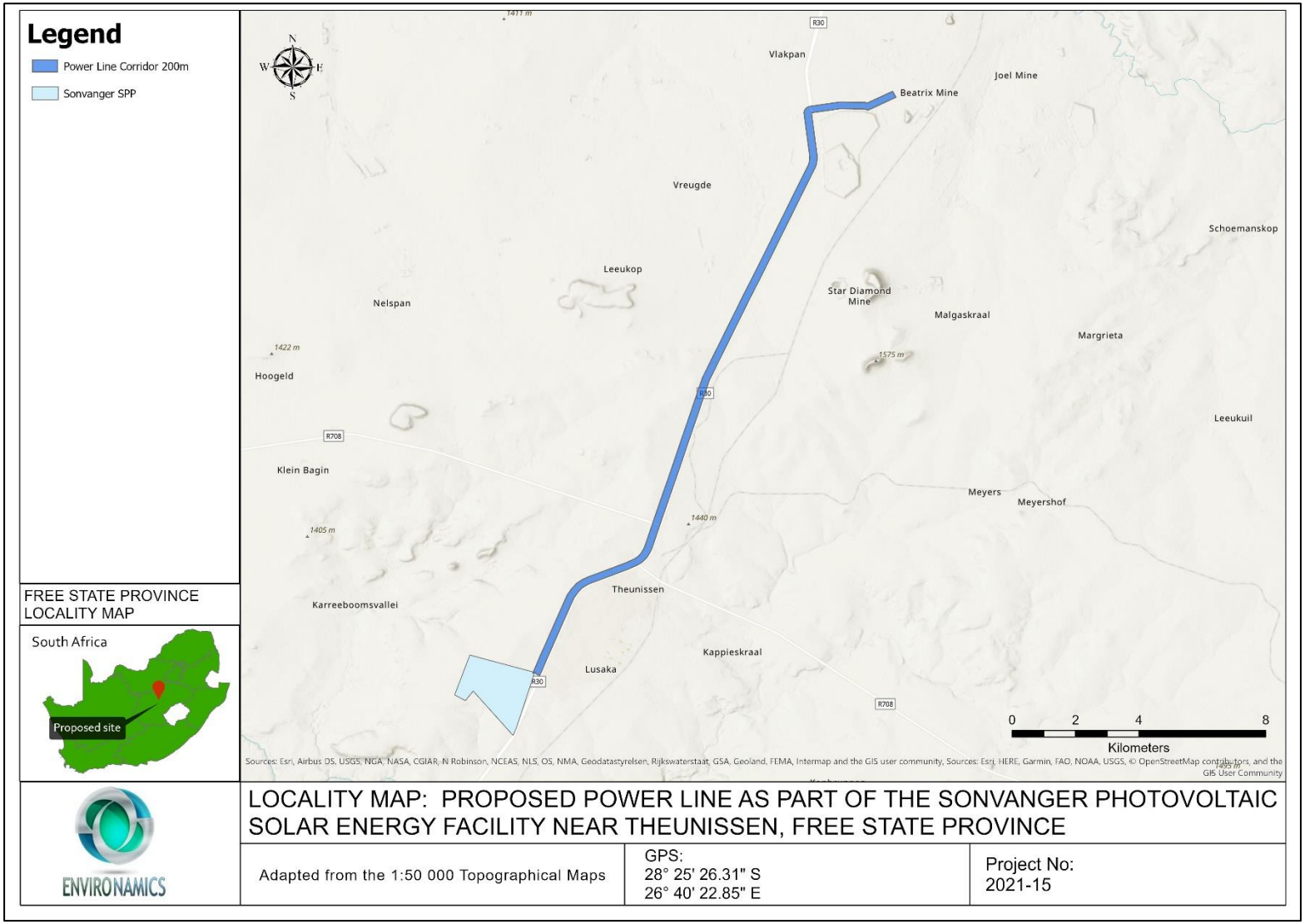

Figure 4. Regional Location Map of the proposed powerline corridor

Figure 5. Aerial Map indicating the proposed location of the powerline corridor for the Sonvanger PV Plant

3.2 CLIMATE

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly, and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). The climate for the region can be described as warm-temperate. In terrestrial environments, limitations related to water availability are always important to plants and plant communities.

The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The study area is situated within the summer and autumn rainfall region with very dry winters and frequent frost that occurs during the colder winter months. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The mean annual precipitation for the region is around 560mm. The mean annual temperature for the area is 15.2°C, and the mean annual frost days is 43 days. Mean Annual Potential Evaporation is 2226mm, with Mean Annual Soil Moisture Stress of 78%.

3.3 GEOLOGY AND SOIL TYPES

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area include the Bd20 and Dc16 land types (Land Type Survey Staff, 1987) (ENPAT, 2001). The land type, geology and associated soil types is presented in Table 2 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 2. Land types, geology, and dominant soil types of the proposed development site

Landtype	Soils	Geology
Bd20	Plinthic catena: eutrophic; red soils not widespread upland duplex and margalitic soils rare	Shale, mudstone and sandstone of the Ecca and Beaufort Group. Aeolian and possibly colluvial sand overlies the rocks.
Dc16	Prismacutanic and/or pedocutanic diagnostic horizons dominant. In addition, one or more of: vertic melanic red structured diagnostic horizons	Mudstone, shale, sandstone and grit of the Beaufort Group, Karoo Sequence with dolerite sills

Soils associated with the site vary between very sandy on the plateaus and higher lying areas, to dark clayey soils in the low-lying plains and bottomlands.

3.4 TOPOGRAPHY, LANDUSES AND DRAINAGE

The study area lies completely within the Middle Vaal Water Management Area (WMA) and

entirely within the Highveld ecoregion (Kleynhans et al., 2005).

The topography is characterised by slightly undulating plains with wetlands and / or drainage channels bisecting the area. The topography of the site can be described as generally favourable, when considering that most of the area consists of slopes of less than 1:5. The site is located at an altitude of between 900 and 940 meters above mean sea level (AMSL).

Most properties situated within a 500m radius are being used for livestock and crop cultivation. The proposed development land is used for livestock farming and maize cultivation at present. The natural vegetation of the site is mostly intact.

The site is located within the C41G, C41H and C42K quaternary catchments and is situated in the Middle Vaal Water Management Area. Drainage occurs as sheet-wash into the drainage channels on site that eventually drains into the major river namely the Palmietkuil Spruit and Bosluis Spruit that occurs along the periphery of the powerline corridor as well as the Krom Spruit to the south-east of the powerline corridor.

3.5 SENSITIVITY ANALYSIS AND CONSERVATION ANALYSIS TOOLS

There are several assessments for South Africa as a whole, as well as on provincial levels that allow for detailed conservation planning as well as meeting biodiversity targets for the country's variety of ecosystems. These guides are essential to consult for development projects and will form an important part of the sensitivity analysis. Areas earmarked for conservation in the future, or that are essential to meet biodiversity and conservation targets should not be developed and have a high sensitivity as they are necessary for overall functioning. In addition, sensitivity analysis in the field based on much finer scale data can be used to ground truth the larger scale assessments and put it into a more localised context.

3.5.1 FREE STATE BIODIVERSITY CONSERVATION PLAN

The purpose of the Free State Biodiversity Conservation Plan is to develop the spatial component of a bioregional plan (i.e., map of Critical Biodiversity Areas (CBA) and associated land-use guidelines). The Free Stare Conservation Plan categories for the development are presented in Figure 7. The following can be concluded regarding development:

- Most of the proposed powerline footprint represent ESA1 or ESA2 areas although most of these areas represent cultivated land or degraded grassland. The management objective for this area is to maintain ecosystem functionality and connectivity allowing for limited loss of biodiversity pattern. Therefore, loss has already occurred due to cultivation and degradation.
- Small sections represent CBA1 areas, although the site is more representative of ESAs.
- The remainder of the area represent "Other' areas or "Degraded" areas.

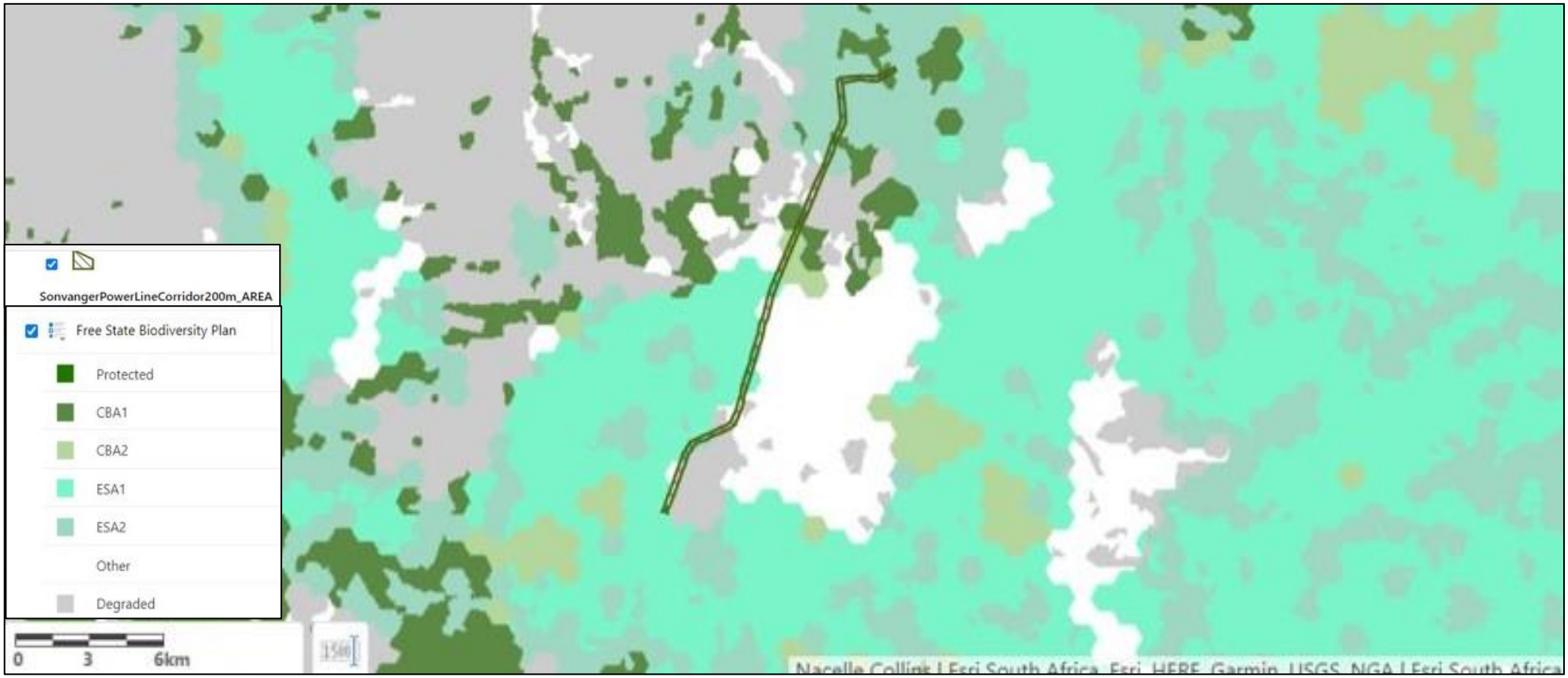

Figure 6. Free State C-Plan Map (2015) for the project area

3.5.2 PROTECTED AREAS NETWORK AND NATIONAL PROTECTED AREAS EXPANSION STRATEGY (NPAES)

Officially protected areas, either provincially or nationally that occur close to a powerline corridor could have consequences as far as impacts on these areas are concerned. For the proposed development and associated infrastructure no protected areas occur in proximity, with the closest being the Wille Pretorius Game Reserve that occurs to the east of the project area (Figure 7). Based on the distance between the development and the protected area, no impact is expected to occur.

The NPAES are areas designated for future incorporation into existing protected areas (both National and informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. The project area is bordered by the Free State Highveld Grassland NPAES, although the development of the powerline will not impede on the NPAES (Figure 7).

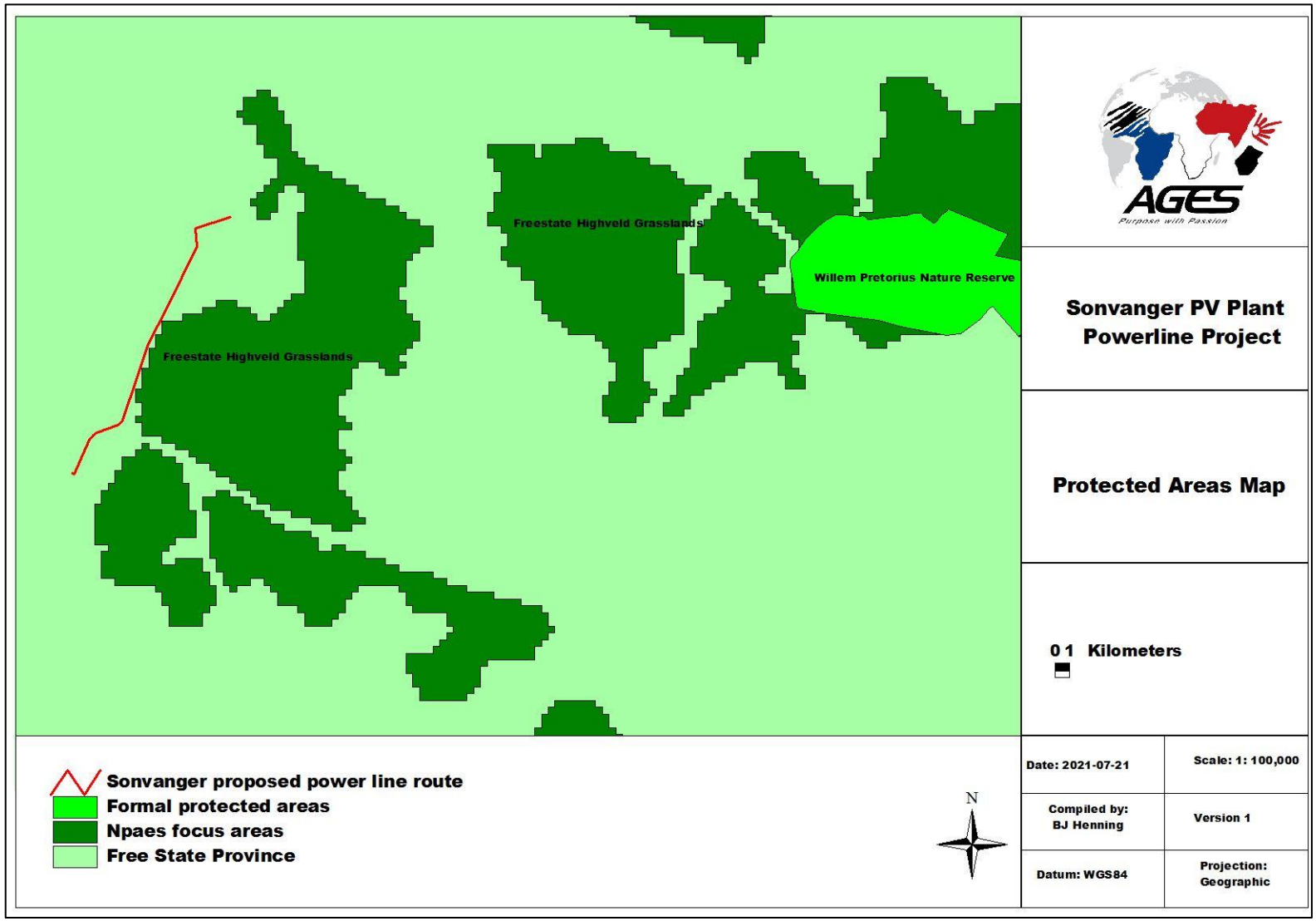

Figure 7. Location of the project area in relation to listed protected areas.

3.5.3 IMPORTANT BIRD AREAS

An Important Bird Area (IBA) is an area recognized as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBA's, covering over 14 million hectares of habitat for our threatened, endemic and congregatory birds. Yet only million hectares of the total land surface covered by our IBA's is legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013). The project area is not located within an IBA with the Willem Pretorius Game Reserve IBA being the closest IBA located to the east of the project area (Figure 8).

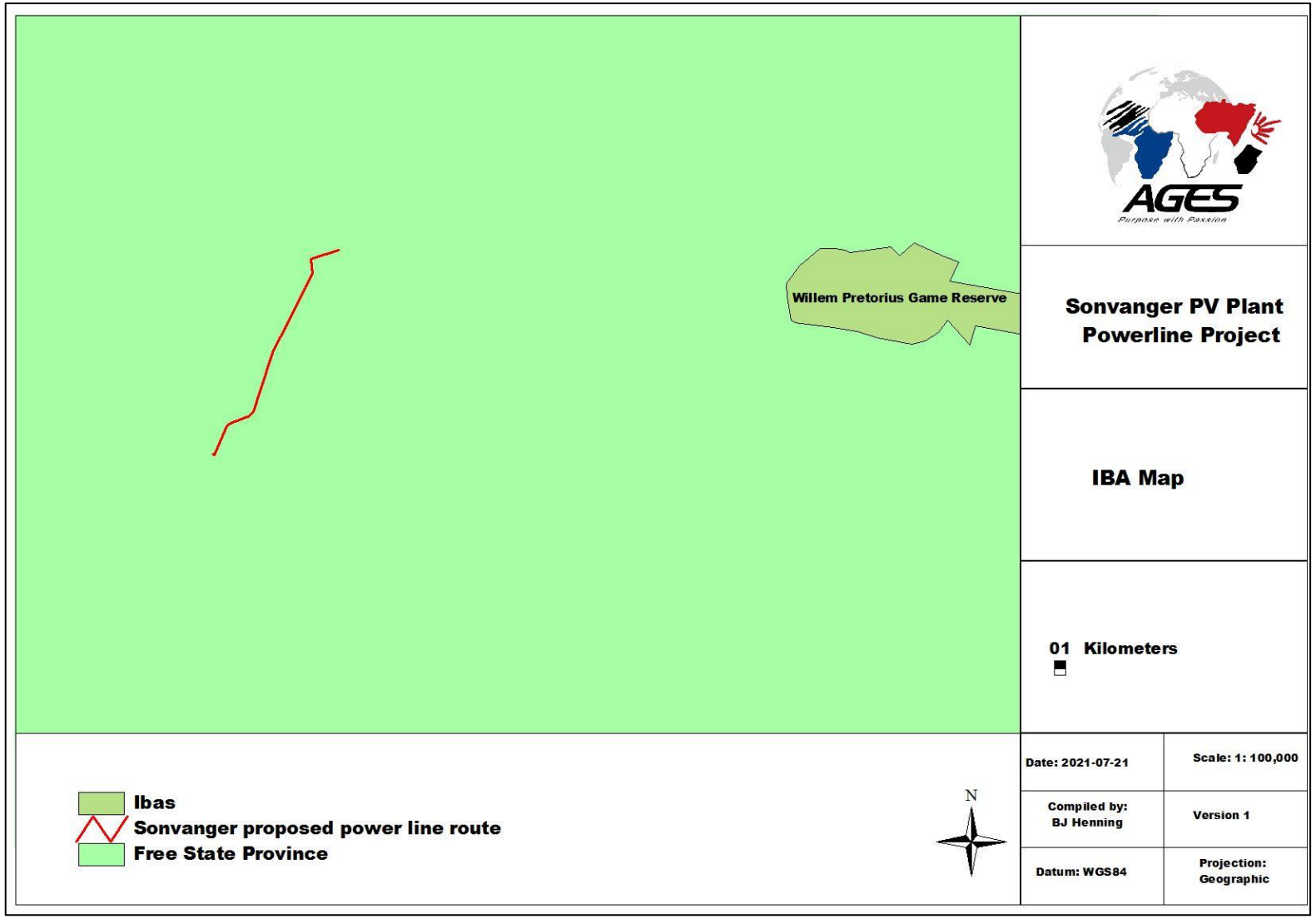

Figure 8. IBAs near the project area (Birdlife SA)

3.5.4 NATIONALLY THREATENED ECOSYSTEMS

The list of national Threatened Ecosystems has been gazetted (NEM:BA: National list of ecosystems that are threatened and in need of protection) and result in several implications in terms of development within these areas. Four basic principles were established for the identification of threatened ecosystems. These include:

- The approach must be explicit and repeatable.
- The approach must be target driven and systematic, especially for threatened ecosystems.
- The approach must follow the same logic as the IUCN approach to listing threatened species, whereby a few criteria are developed, and an ecosystem is listed based on its highest-ranking criterion: and
- The identification of ecosystems to be listed must be based on scientifically credible, practical, and simple criteria, which must translate into spatially explicit identification of ecosystems.

Areas were delineated based on as fine a scale as possible and are defined by one of several assessments: These areas are essential for conservation of the country's ecosystems as well as meeting conservation targets. The project area is located partially within the Vaal-Vet Sandy Grasslands Listed Threatened Ecosystem along the powerline corridor (Figure 9), which is categorized as Endangered.

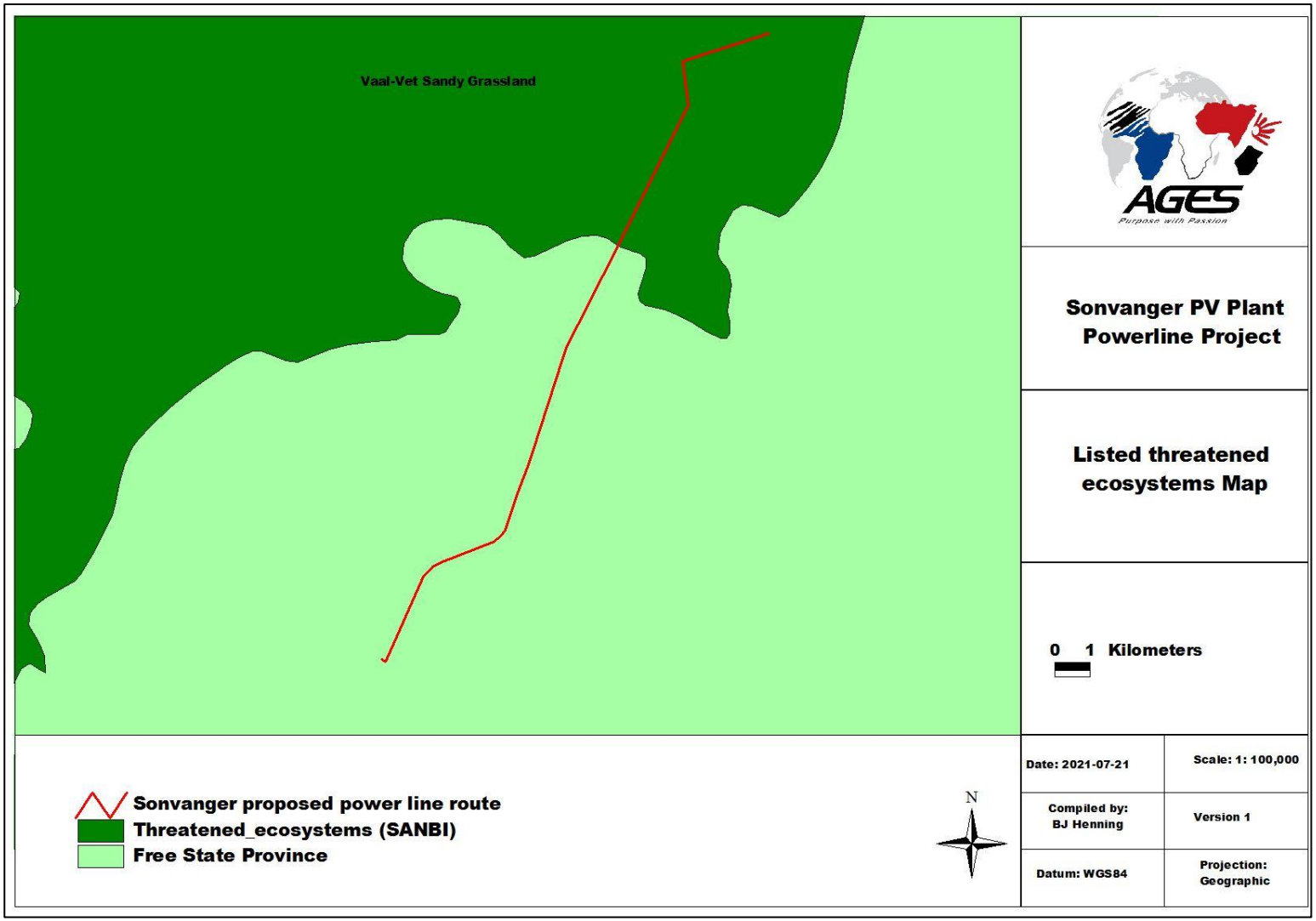

Figure 9. Listed threatened ecosystems in proximity to the proposed development site (SANBI).

3.5.5 STRATEGIC WATER SOURCE AREAS (SWSA), NATIONAL FRESHWATER ECOSYSTEM PRIORITY AEAS (NFEPA) STATUS OF RIVERS AND WETLANDS ON SITE

NFEPA maps provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or 'FEPAs'. NFEPA maps were developed using the principles of systematic biodiversity planning, also known as systematic conservation planning (Margules and Pressey 2000). Systematic biodiversity planning is a well-established field of science in which South Africa is considered a world leader (Balmford 2003). The NFEPA maps and supporting information form part of a comprehensive approach to sustainable and equitable development of South Africa's scarce water resources. For integrated water resources planning, NFEPA provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). NFEPA products are therefore directly applicable to the National Water Act, feeding into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives. NFEPA products are also directly relevant to the National Environmental Management: Biodiversity Act (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act. NFEPA products support the implementation of the National Environmental Management: Protected Areas Act (Act 57 of 2003) by informing the expansion of the protected area network.

The project area is located within proximity of a few NFEPA rivers, namely the Palmietkuilspruit, Bosluissprut and Kromspruit. None of the powerline corridor is bisected by NFEPA Rivers or wetlands, although some NFEPA pans occur near the powerline corridor as indicated in Figure 10.

Strategic Water Source Areas (SWSAs) are now defined as areas of land that either:

- Supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important; or
- Have high groundwater recharge and where the groundwater forms a nationally important resource; or
- Areas that meet both criteria (a) and (b).

They include transboundary Water Source Areas that extend into Lesotho and Swaziland. All surface water SWSAs are in high rainfall areas where baseflow is at least 11 25 mm/a, which is evidence of a strong link between groundwater and surface water in the SWSAs. The aquifers sustain baseflow, contribute to runoff and, especially, contribute to dry season flows. Sustained river flows are important as they support people and communities who depend directly on rivers for their water, especially during the dry season and droughts.

The 2018 national and transboundary surface-water SWSAs cover about 124 075 km^2 (10% of the region) and provide a MAR of 24 954 million m^3 (50% of the total). The greatest volume of MAR is generated by the Southern Drakensberg (9% of national and transboundary MAR), followed by the Eastern Cape, Northern Drakensberg and Maloti Drakensberg, and the Boland. The Boland has the highest MAR per unit area (3588 m^3/ha/year), followed by Table Mountain, the Northern Drakensberg and the Mpumalanga Drakensberg.

Seven of these SWSAs are transboundary areas because Lesotho and Swaziland include portions of important SWSAs for South Africa. The portions of the SWSAs that fall within Lesotho (Eastern Cape, and the Southern, Northern and Maloti Drakensberg) cover 18 570 km^2 and generate a MAR of about 3522 million m^3. This MAR sustains the Orange and Caledon Rivers and supplies water to Gauteng via the Lesotho Highlands water supply system. In the case of Swaziland, the portions of the SWSAs falling in this country (Ekangala Drakensberg, Mbabane Hills, Upper Usutu) total 9376 km^2 and produce a MAR of about 2053 million m^3. In total, the SWSAs in these two countries produce about 11% of the total MAR, which is a substantial contribution that needs to be protected.

The project area is not located within any SWSA as indicated in Figure 10.

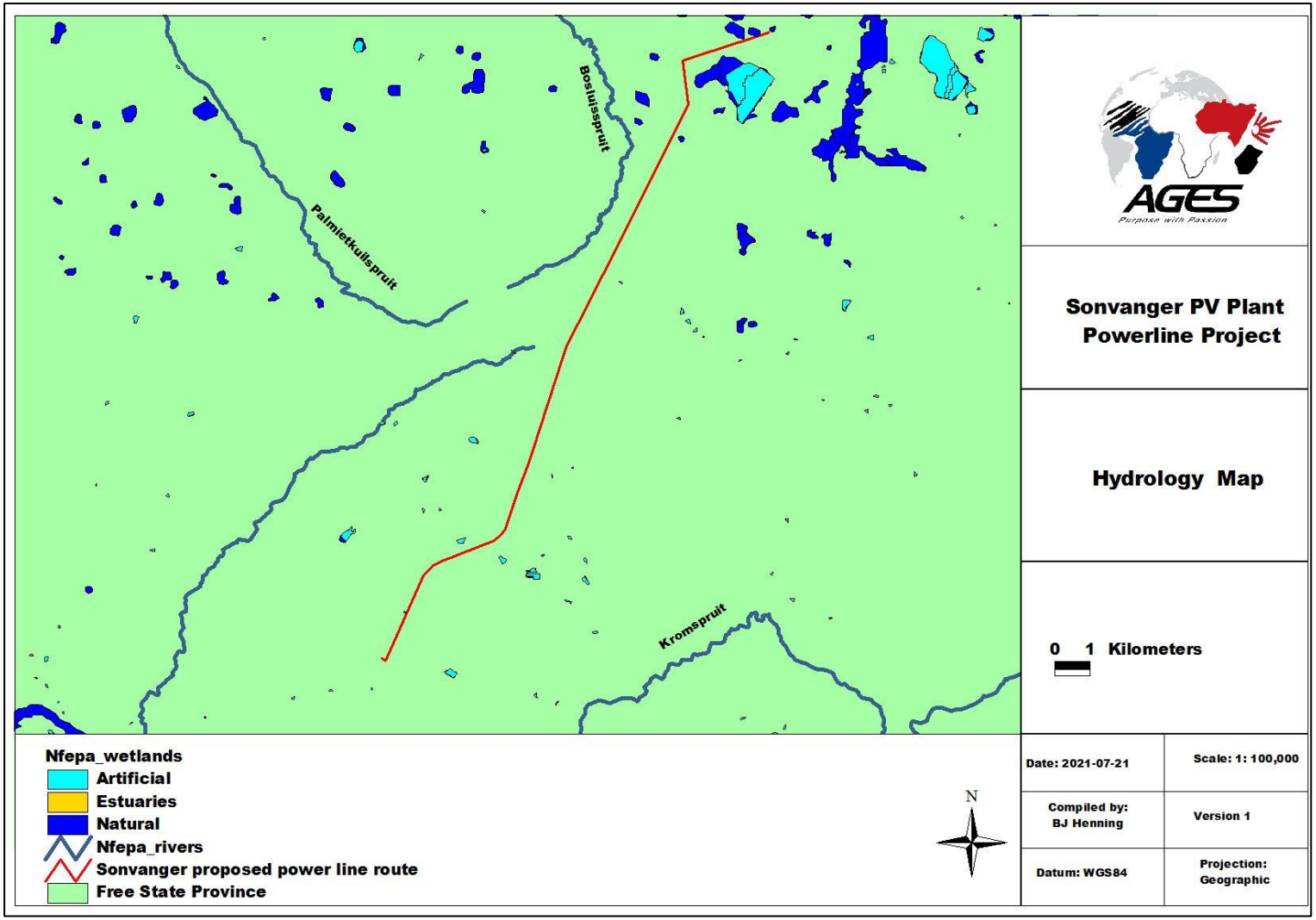

Figure 10. Location of the project area/ powerline corridor in relation to NFEPA Rivers and SWSA

4 RESULTS

4.1 VEGETATION

4.1.1 Biome and Ecoregion

The development site lies within the Grassland Biome which is found chiefly on the high central plateau of South Africa. Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. Trees are absent except in a few localised habitats. Geophytes are often abundant. Frost, fire and grazing maintain the grass dominance and prevent the establishment of trees (Low & Rebelo, 1996).

The Highveld Ecoregion draws its name from the high interior plateau known as the Highveld, and the expansive cover of species-rich communities of grasses. The ecoregion is bordered by the Drakensberg in the east, the arid Karoo and Kalahari in the west, and the low-lying bushveld to the north. The Highveld Plateau is flat with elevations varying from 1,400 m to 1,800 m. The flat topography means that the landscape is traversed by many meandering rivers, with the grassland community historically playing an important role in natural water purification of the westward flowing rivers that originate on the Drakensberg escarpment (Davies and Day 1998). The functioning of this ecosystem has been disrupted in many areas by water transfer projects that have been built to supply greater Johannesburg with water (Davies and Day 1998).

The Highveld Grassland Ecoregion has further suffered extensive degradation. Because it is one of the best areas for farming in South Africa, large tracts of land have already been converted to agriculture, mainly for corn production. Urban expansion, fire, and overgrazing have led to increased fragmentation, as has coal mining and afforestation for stands of exotic trees, especially by species of Eucalyptus (Low and Rebelo, 1998; Cowling et al. 1997). Over several hundred years, particularly around towns, planted wattle (*Acacia mearnsii*) has become invasive, and is prone to rapid expansion upriver watersheds. In the future, expanded surface activity associated with mining below the grassland may become a greater concern as companies develop new technology to make deep mining of coal more profitable (Mallett 1999).

4.1.2 Ecosystem drivers and ecological services

Fire and grazing are two of the most important ecological drivers in grassland. Any land-use change that results in reduced ability to manage fire or grazing in the remaining natural areas will have significant implications for grassland biodiversity. Invasive alien species and soil erosion are two of the most pervasive management issues affecting all grassland ecosystems and are key indicators that the limits of acceptable change have been exceeded.

The Highveld also plays an important role in natural water purification, as the peat formed here has been shown to filter out 90 percent of the harmful chemicals in herbicides. Peat is also useful in absorbing various other pollutants, as a source of fuel, in horticulture, and for

medicinal purposes. In South Africa, where clean water resources are already particularly valuable, this natural filter is being extracted from the Highveld at an unprecedented rate. Approximately 60 percent of locally extracted peat is used to grow mushrooms, while the remaining 40 percent comprises "environmentally friendly" potting soil and compost. Peat has an extremely slow regeneration rate, increasing between 0.7 mm to 1.2 mm per year depending on environmental conditions (Dada 1999). Given its slow formation process, it is unlikely this resource will recover from the damage caused by its rapid removal. Hence, the Highveld's role as a natural filtration element for scarce water resources could be in danger. The preservation of this resource is imperative and could be fulfilled by moderating or halting the use of peat for gardening purposes.

4.1.3 Vegetation types

The most recent classification of the area by Mucina & Rutherford (2006) shows that the site is classified as Central Free State Grassland and Vaal-Vet Sandy Grassland (Figure 11).

The landscape of the Central Free State Grasslands is characterised by undulating plains supporting short grassland. Under natural conditions it is dominated by *Themeda triandra* but is dominated by *Eragrostis curvula* and *E. chloromelas* in disturbed habitats. Dwarf Karoo-shrubs establish in severely degraded clayey bottomlands and overgrazed and trampled low-lying areas are prone to *Vachellia karroo* encroachment. From a conservation point of view, this unit is described as Least Concern. Almost a quarter of the area of it is being transformed for crop cultivation and building of large dams such as Allemanskraal, Erfenis, Groothoek, Koppies, Weltevrede and Kroonstad Dams. Small portions are conserved in the Willem Pretorius, Rustfontein and Koppies Dam Nature Reserves as well as in some private nature reserves.

The Vaal-Vet Sandy Grasslands vegetation unit is described as plains-dominated landscape with some scattered slightly irregular undulating plains and hills. Mainly low tussock grasslands with an abundant karroid element. *Themeda triandra* is dominant in this vegetation unit. This vegetation type is described as Endangered because approximately 63% of it has been transformed for commercial crop cultivation and grazing pressure from cattle and sheep. Only 0.3% of this vegetation type is statutorily conserved in Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves.

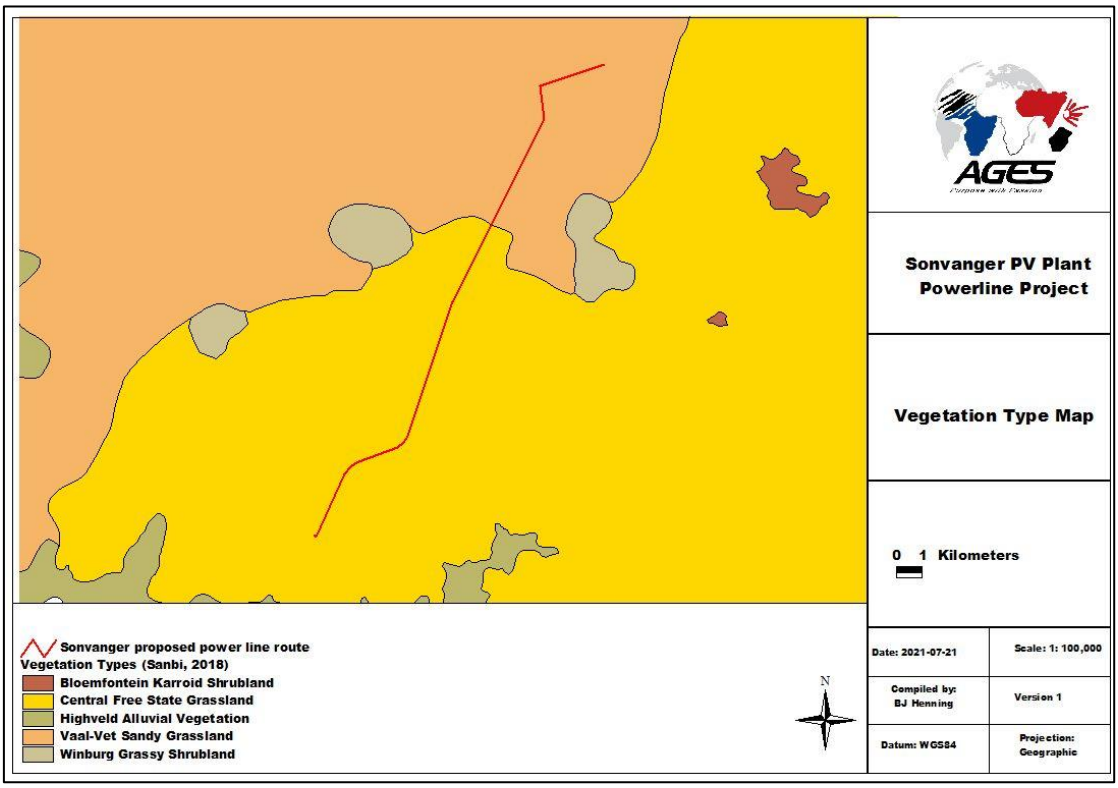

Figure 11. Vegetation Types of the proposed Sonvanger PV Plant powerline corridor

4.1.4 Vegetation units

The proposed development site occurs on a landscape that varies from slightly undulating to flat plains bisected by drainage channels. The importance to survey the area to have a better understanding of the ecosystem and the potential impact of the power line on the natural environment was identified as a key factor, and subsequently the footprint areas was completely surveyed. The powerline corridor forms part of a larger area used for livestock farming and maize cultivation, as well as mining activities in the north. The vegetation units on the site vary according to soil characteristics, topography, and land-use. Vegetation units were identified within the power line corridor and can be divided into 7 distinct vegetation units according to soil types, land use and topography.

The vegetation communities identified within the corridor are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape. The physiographic-physiognomic units will be referred to as vegetation units in the following sections. These vegetation units are divided in terms of the land-use, plant species composition, topographical and soil differences that had the most definitive influence on the vegetation units. Each unit is described in terms of its characteristics and detailed descriptions of vegetation units are included in the following section. A species list for the site is included in Appendix B, while a plant species list for the quarter degree grid square (QDS) is included in Appendix A. Photographs of each unit is included in the next section to illustrate the grass layer, woody structure, and substrate (soil, geology etc.). The following vegetation

units were identified during the survey.

1. Mixed *Themeda triandra* grassland.
2. Degraded grassland.
3. *Vachellia karroo – Asparagus laricinus* woodland.
4. Cultivated land (Maize fields).
5. Exotic bushclumps.
6. Built up land / mining infrastructure.
7. Drainage features:
    - Valleybottom wetlands (with and without channels).
    - Floodplains Rivers.
    - Endorheic depressions (pans & offstream dams).

The vegetation units for the powerline development are presented in Figure 12:

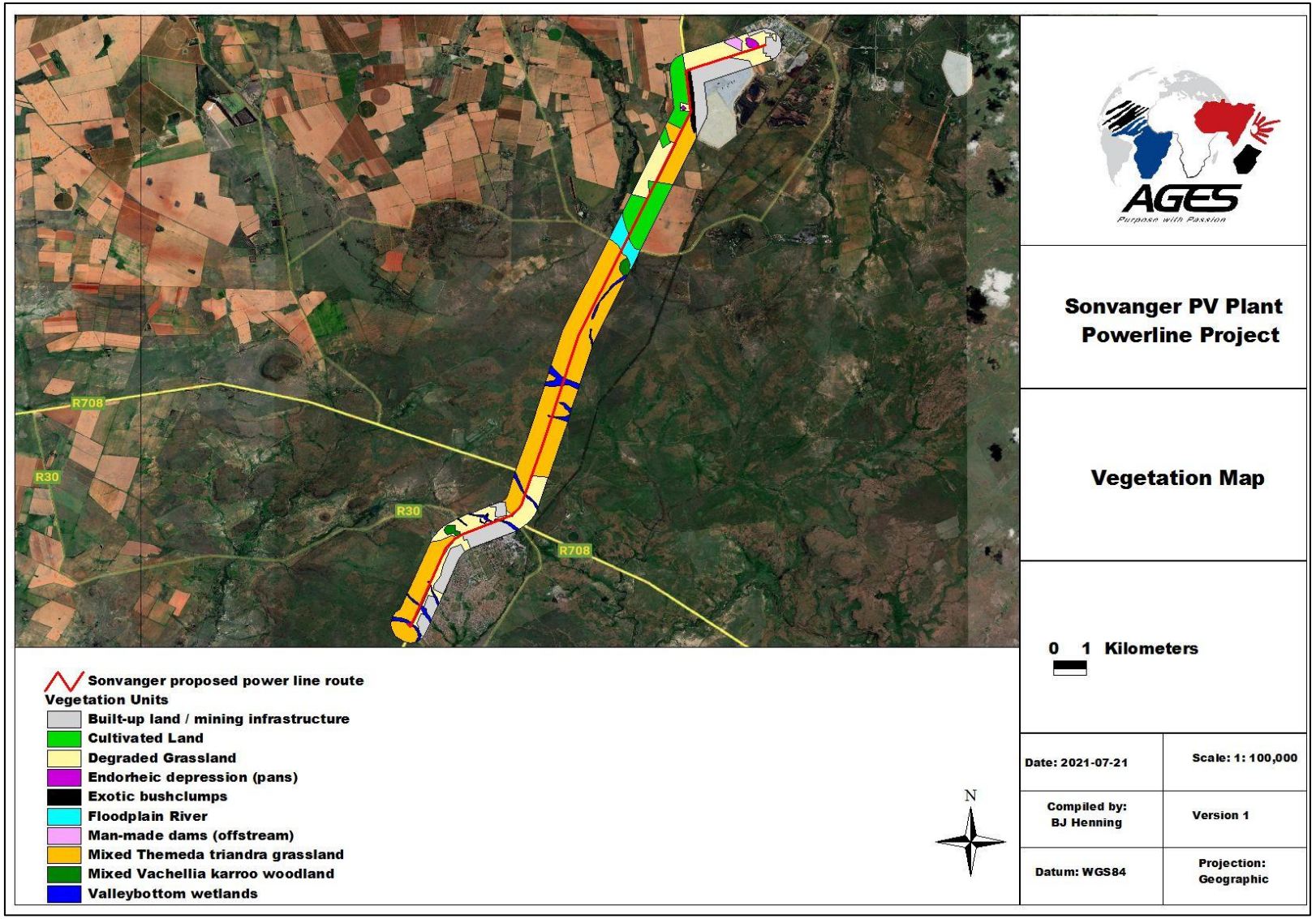

Figure 12. Vegetation Unit Map of the proposed powerline corridor

4.1.4.1 Mixed *Themeda triandra* grassland

This grassland vegetation unit is described as typical Central Free State Grassland by Mucina & Rutherford (2006) and occurs in the central and southern sections of the proposed powerline corridor. The grass layer is well developed and underlied by red-yellow apedal soils (Hutton soil form) or dark clayey soils of the Arcadia or Swartland Soil Forms. Grasses that dominate on the clayey soils are species such as *Aristida congesta, Eragrostis lehmanniana, Setaria sphacelata* and *Themeda triandra*. The vegetation structure is tall, closed grassland. No red listed or protected species were documented in the unit. The characteristics of this vegetation unit are summarized in Table 3, while the state of the vegetation indicated in photograph 1.

Table 3. Botanical analysis and characteristics of the Mixed *Themeda triandra* grassland

Vegetation unit characteristics	
State of the vegetation:	Natural grassland in a slightly degraded state
Need for rehabilitation	Low
Conservation priority	Medium
Soils & Geology	Red to Black clayey soils of the Hutton or Swartland / Arcadia soil form
Density of woody layer	Trees: <1% (avg. height: 3-6m) Shrubs:<1% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 70-80% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit should be adhered to:

- The vegetation unit is classified as having a medium sensitivity due to the widespread status through the larger area.
- The development of the powerline is considered suitable in this area.

Photograph 1. Mixed T*hemeda triandra* clay grassland in the corridor

4.1.4.2 Degraded grassland

The areas adjacent to mining infrastructure and townships are classified as degraded grassland on red-yellow apedal soils of the Oakleaf soil form or Clovelly soil form. According to the soil types and previous land use, the vegetation unit is divided into two variations namely a *Hyparrhenia hirta* degraded grassland close to the Theunissen township area, and primary old fields dominated by *Cynodon dactylon* and *Eragrostis plana* in the northern section of the corridor. The grass layer is well developed and dominated by species such as *Hyparrhenia hirta, Cynodon dactylon, Eragrostis plana, Eragrostis chloromelas* and various exotic weeds such as *Tagetes minuta*. The state of the vegetation is indicated in photograph 2, while the characteristics of the variations of this vegetation unit are summarized in Table 4.

Table 4. Botanical analysis and characteristics of degraded grassland

Vegetation unit characteristics	
State of the vegetation:	Degraded grassland
Need for rehabilitation	Medium-High
Conservation priority	Low
Soils & Geology	Red-yellow apedal sandy soils of the Clovelly / Hutton soils / yellowish soils of the Oakleaf soil form
Density of woody layer	Trees: <1% (avg. height: 3-6m) Shrubs:<1% (avg. height: 1-2m)
Density of herbaceous	Grasses: 70-80% (avg. height: 0.8-1.2m)

Vegetation unit characteristics	
layer	Forbs: <1% (avg. height: 0.8m)
Sensitivity	Low
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to:

- The vegetation unit is classified as having a Low sensitivity due to the degraded state of the herbaceous layer.
- The development of the powerline is considered suitable in this area.

Photograph 2. Degraded grassland in the powerline corridor

4.1.4.3 Vachellia karroo – Asparagus laricinus woodland

The microphyllous woodland vegetation unit occurs on soils that vary from red apedal soils of the Hutton soil form or black clayey soils of the Arcadia soil form. The woody layer is dominated by species such as *Vachellia karroo, Vachellia tortilis* and *Ziziphus mucronata*. The woody structure varies from being open woodland to slightly denser woodland with bushclumps in some areas. The grass layer is in a slightly degraded state due to previous overgrazing and dominated by *Setaria sphacelata, Themeda triandra* and *Panicum maximum*. The state of the vegetation is indicated in photograph 3, while the characteristics of the variations of this vegetation unit are summarized in Table 5.

Table 5. Botanical analysis and characteristics of Open *Vachellia karroo* woodland

Vegetation unit characteristics	
State of the vegetation:	Microphyllous woodland in a slightly degraded state
Need for rehabilitation	Low
Conservation priority	Medium
Soils & Geology	Red-yellow loamy soils of the Hutton soils or black clayey soils of the Arcadia soil form
Density of woody layer	Trees: 10% (avg. height: 3-6m) Shrubs:5-10% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 70-80% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	Medium
Red data species	None observed
Protected species	None observed

The following specific recommendations for the vegetation unit regarding the proposed development should be adhered to:

- The vegetation unit is classified as having a medium sensitivity due its widespread occurrence in the Grassland Biome.
- The development of the powerline is considered suitable in this area.

Photograph 3. *Vachellia karroo* woodland in the project area

4.1.4.4 Cultivated land (Maize fields)

The croplands in the northern section of the corridor form ploughed lands or homogenous stands of maize on sandy soils (Photograph 4). Exotic weeds and pioneer grasses often colonize the areas surrounding the croplands. No detailed survey was considered for this area due to the completely modified state of the vegetation and the area has a low sensitivity.

Photograph 4.Croplands in the powerline corridor

4.1.4.5 Exotic bushclumps

A small section of the project area is characterised by homogenous stands of exotic trees such as *Eucalyptus camaldulensis* (Photograph 5). Exotic weeds and pioneer grasses often colonize the areas surrounding these bushclumps. No detailed survey was considered for this area due to the completely modified state of the vegetation and the area has a low sensitivity. None of the area will be impacted on by the powerline development

Photograph 5.*Eucalyptus* bushclump in the powerline corridor

4.1.4.6 Bare ground / built-up land / infrastructure

The northern and southern sections of the project area / powerline corridor represents completely modified built-up land and mining infrastructure. This area is completely modified and colonised by various alien invasive species and other exotic weeds. No detailed survey was considered for this area due to the completely modified state of the vegetation and the area has a low sensitivity.

4.1.4.7 Drainage features

4.1.4.7.1 Valleybottom wetlands

A few valleybottom wetlands were identified in the central and southern section of the powerline corridor. Valley bottom wetlands are classified as low-lying, gently sloped areas that receive water from an upstream channel and/or form adjacent hillslopes, not subject to periodic over-bank flooding by a river channel. Surface water in the valley bottom wetlands of the study area flows only seasonally, although the channels are in most cases non-perennial. This wetland vegetation comprises atypical (azonal) vegetation, mainly because of the prolonged moist conditions of the soils. The soils are clayey and do have relatively high water retention abilities.

A channelled valley-bottom wetland is classified as a mostly flat valley-bottom wetland dissected by and typically elevated above a channel (Photograph 6). Dominant water inputs to these areas are typically from the channel, either as surface flow resulting from overtopping of the channel bank/s or as interflow, or from adjacent valley-side slopes (as overland flow or

interflow). Water generally moves through the wetland as diffuse surface flow, although occasional, short-lived concentrated flows are possible during flooding events. Small depressional areas within a channelled valley-bottom wetland can result in the temporary containment and storage of water within the wetland. Water generally exits in the form of diffuse surface flow and interflow, with the infiltration and evaporation of water from these wetlands also being potentially significant (particularly from depressional areas). The hydrodynamic nature of channelled valley-bottom wetlands is characterised by bidirectional horizontal flow, with limited vertical fluctuations in depressional areas (SANBI, 2009).

Unchannelled valley-bottom wetland can be described as: a mostly flat valley-bottom wetland area without a major channel running through (Photograph 7). This wetland type is characterised by an absence of distinct channel banks and the prevalence of diffuse flows, even during and after high rainfall events. Water inputs are typically from an upstream channel, as the flow becomes dispersed, and from adjacent slopes (if present) or groundwater. Water generally moves through the wetland in the form of diffuse surface flow and/or interflow (with some temporary containment of water in depressional areas), but the outflow can be in the form of diffuse or concentrated surface flow. Infiltration and evaporation from unchannelled valley-bottom wetlands can be significant, particularly if there are a few small depressions within the wetland area. Horizontal, unidirectional diffuse surface-flow tends to dominate in terms of the hydrodynamics.

The vegetation structure of the valley bottom wetlands varies from the actual channels being closed grassland in certain areas, to a muddy riverbed with alluvial sand and reeds along the riverbanks. The drainage channels that from part of the channelled valley bottom wetlands is mostly perennial.

The most abundant and most conspicuous plant species is hygrophilous grasses such as *Andropogon eucomis, Hyparrhenia tamba, Eragrostis gummiflua* and *Setaria sphacelata*. Other plants associated with valley bottom channels are *Juncus effusus, Schoenoplectus corymbosus, Verbena bonariensis, Persicaria serrulata* and *Typha capensis*.

Unfortunately, the valley bottom wetlands provide a distribution route for weeds and invading trees. Many of the usual weeds were recorded together with *Xanthium strumarium* (Large cocklebur) *Datura stramonium, Tagetes minuta* and *Bidens bipinnata*. Weeds and invaders should be removed, as well as destruction of such plants in a safe place and manner.

Photograph 6. Valleybottom wetland with channel in the powerline corridor

Photograph 7. Valleybottom wetland without channel in the powerline corridor

4.1.4.7.2 Depressions

The depressions in the project area / powerline corridor can be classified into two variations namely man-made dams (Photograph 8) or natural pans classified as endorheic depressions (Photograph 9). A depression is classified as 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, ground water discharge, interflow and (diffuse or concentrated) overland flow. For 'depressions with channelled inflow', concentrated overland flow is typically a major source of water for the wetland, whereas this is not the case for 'depressions without channelled inflow'. Dominant hydrodynamics are (primarily seasonal) vertical fluctuations. Depressions may be flat-bottomed (in which case they are often referred to as 'pans') or round-bottomed (in which case they are often referred to as 'basins') and may have any combination of inlets and outlets or lack them completely. Water exits by means of concentrated surface flow in channels for exorheic depressions, although the primary means of water still exits as evaporation.

The vegetation associated with depressions is mostly sedges and bulrushes depending on the depth of the water and the substrate. Species such as *Persicaria serullata, Typha capensis, Schoenoplectus corymbosus, Ludwigia stolonifer* and *Leersia hexandra* mostly grow along the shallow edges of dams and pans in the project area on a muddy substrate. The riparian woodland is characterised by *Vachellia karroo, Ziziphus mucronata* and *Grewia flava*.

Photograph 8. Man-made dam and concrete canal in the powerline corridor

Photograph 9. Endorheic depression (pan) in the powerline corridor

4.1.4.7.3 River channels and floodplains

The major river in the northern section of the project area (Photograph 10) with the associated riparian vegetation are ecologically sensitive, forming important, limited and specialised habitats for several plant and fauna species. The species composition is unique and relatively limited in distribution and coverage. This habitat also forms linear corridors linking different open spaces. The riverine woodland would be important dry season refuge areas for many fauna species in their natural state. It is also a centre of floral diversity. Riparian areas have been identified as important dry season refuge areas for a variety of large mammal species. The impacts on the sensitive riparian ecosystems, regardless of the source, need to be restricted. Impacts on this system include erosion, habitat loss and degradation and the associated impacts on faunal and floral diversity, dewatering of marshes and wetlands, water abstraction as well as increased sedimentation (SANParks 2003). Continued impacts on the riverine ecosystems may also ultimately reduce the capacity of this system to absorb dramatic flooding events. The band of trees that occurs along the channel can be classified as riparian vegetation. This vegetation is very important for connectivity with adjacent vegetation as well as a migratory route for riparian animals.

The drainage channel on site is non-perennial. Channels are subdivided further within this level of the hierarchy into six geomorphological zones, as defined by Rowntree and Wadeson (2000). These zones are based largely on gradient which influences flow velocity and channel

characteristics such as substratum particle size that are important characteristics of riverine habitat types. The following geomorphological zones occur in the project area and described as follows (after Rowntree and Wadeson 2000):

- Lowland River: a low-gradient alluvial fine-bed channel. It may be confined but has a fully developed meandering pattern within a distinct floodplain that develops in unconfined reaches where there is increased silt content in bed or banks. Characteristic gradient: 0.0001- 0.001.

The Palmietspruit that bisects the area can be described as a floodplain river or a lowland river. The floodplain is not classified as a floodplain wetland, but a river with some wetland characteristics in the channel and its banks.

A floodplain, is flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge (Figure 13). It includes the floodway, which consists of the stream channel and adjacent areas (riparian woodland, hydrophilic grassland, Photograph 10) that carry flood flows, and the flood fringe, which are areas covered by the flood, but which do not experience a strong current. In other words, a floodplain is an area near a river or a stream which floods easily. Floodplains are made by a meander eroding sideways as it travels downstream. When a river breaks its banks and floods, it leaves behind layers of rock and mud. These gradually build up to create the floor of the flood plain. Floodplains generally contain unconsolidated sediments, often extending below the bed of the stream. These are accumulations of sand, gravel, loam, silt, and/or clay, and are often important aquifers, the water drawn from them being pre-filtered compared to the water in the river.

The vegetation associated with the floodplain is mostly microphyllous woodland and hygrophilous grasses in the project area. Species such as *Vachellia karroo, Searsia pyroides, Ziziphus mucronata* and *Searsia lancea* mostly grow in the floodplain area (Photograph 13), together with grass species such as *Sporobolus africanus* and *Eragrostis rotifer*.

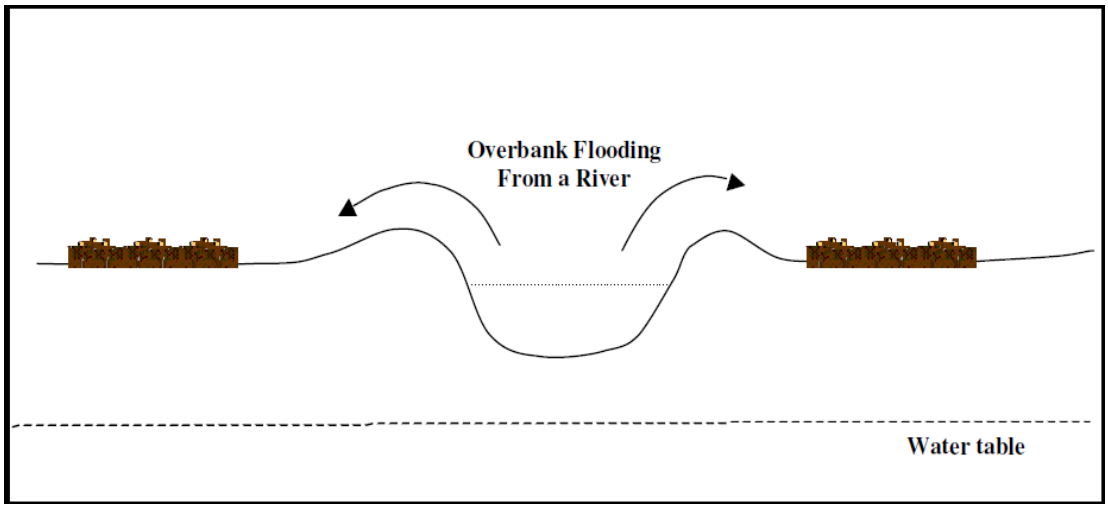

Figure 13. Cross section through a floodplain

Photograph 10 The floodplain river in the project area of the powerline corridor

4.2 PLANT SPECIES LEVEL ASSESSMENT

South Africa has been recognized as having remarkable plant diversity with high levels of endemism. The major threats to plants in the study area are urban expansion, non-sustainable harvesting, collecting, overgrazing/browsing, mining and agriculture. The objective of this section was to compile a list of plant species for which there is conservation concern. This includes threatened, rare, declining, protected, and endemic species.

4.2.1 Species of conservation concern

Species of conservation concern are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient – Insufficient Information (DDD). It should also be noted that not all species listed as protected are threatened or vice versa. A list of SCC plant species previously recorded in the study area in which the proposed development is planned was obtained from the Plants of Southern Africa (POSA) database of SANBI. Figure 14 indicates the classification system used by Sanbi for SCC:

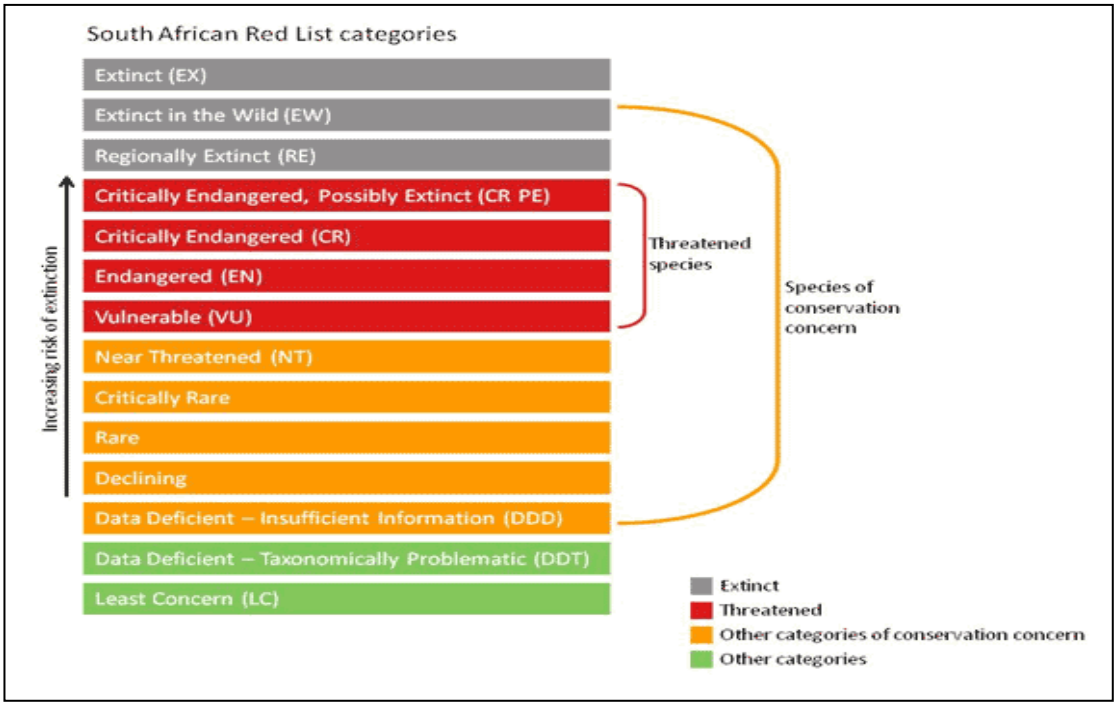

Figure 14. South African red list categories indicating the categories to be used for Species of Conservation Concern

Habitat degradation is one of the main reasons for plant species becoming extinct in a particular area. Threatened species are also seen as indicators of the overall health of an ecosystem (Hilton-Taylor, 1996).

A list of red data plant species previously recorded in the grid square in which the proposed development is planned was obtained from SANBI. No red listed plant species occur in the QDS or was recorded in the project area / powerline corridor.

Ecological monitoring should however still be implemented during the construction phase and specific sensitive habitats (riparian) needs to be avoided to ensure that any potential red data species potentially missed during the field surveys are preserved and not potentially impacted on. The EIA screening tool also did not highlight any red listed flora.

4.2.2 Protected Plants (Free State Nature Conservation Ordinance)

Plant species are also protected in the Free State Province according to the Free State Nature Conservation Ordinance. According to this ordinance, no person may pick, import, export, transport, possess, cultivate, or trade in a specimen of a specially protected or protected plant species. The Appendices to the ordinance provide an extensive list of species that are protected, comprising a significant component of the flora expected to occur on site. Communication with Provincial authorities indicates that a permit is required for all these species if they are expected to be affected by the proposed project.

After a detailed survey was conducted during July 2021, no listed species was confirmed for the site.

4.2.3 Invasive alien species

Invasive alien plants pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. Of the estimated 9000 plants introduced to this country, 198 are currently classified as being invasive. It is estimated that these plants cover about 10% of the country and the problem is growing at an exponential rate.

The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa. Below is a brief explanation of the four categories of Invasive Alien Plants as per the regulation.

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy, or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy, or accept as a gift) involving a Category 3 species. No permits will be issued for Cat 3 plants to exist in riparian zones.

The fight against invasive alien plants is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the DWA. This programme works in partnership with local communities, to whom it provides jobs, and with Government departments including the Departments of Environmental Affairs and Tourism, Agriculture, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies.

WfW currently runs over 300 projects in all nine of South Africa's provinces. Scientists and field workers use a range of methods to control invasive alien plants. These include:

- Mechanical methods - felling, removing, or burning invading alien plants.

- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 bio-control agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required to prevent enormous impacts.

Vehicles often transport many seeds, and some may be of invader species, which may become established along the roads through the area, especially where the area is disturbed. The construction phase of the development will almost certainly carry the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that invasive alien species such as the seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. The following alien invasive and exotic plant species were recorded on site during the surveys as stipulated in the Alien and Invasive Species Regulations (GNR 599 of 2014) (Table 6):

Table 6. Declared weeds and invader plants of the study area.

Species	Category
Argemone ochroleuca	1b
Datura stramonium	1b
Eucalyptus camaldulensis	1b
Opuntia ficus-indica	1b
Opuntia imbricata	1b
Tamarisk chinensis	1b
Verbena brasiliensis	1b
Xanthium strumarium	1b

According to the amended regulations (No. R280) of March 2001 of the Conservation of Agricultural Resources Act 1983 (Act no. 43 of 1983), it is the legal duty of the land user/landowner to control invasive alien plants occurring on the land under their control. The State has the right to clear invasive plants at the landowner's expense if the landowner refuses to remove invasive plants.

4.2.4 General

An important aspect relating to the proposed development should be to protect and manage the biodiversity (structure and species composition) of the vegetation types which are

represented within the powerline corridor. Vegetation removal should be kept to a minimum during the construction phase of the development and only vegetation on the footprint areas should be removed. Mitigation measures and monitoring should however be implemented should the development be approved.

4.3 FAUNAL HABITAT AND ANIMAL SPECIES ASSESSMENT

4.3.1 Overview

A healthy environment is inhabited by animals that vary from micro-organisms to the birds and mammals. The species composition and diversity are often parameters taken into consideration when determining the state of the environment. A comprehensive survey of all animals is a time-consuming task that will take a long time and several specialists to conduct. The alternative approach to such a study is to do a desktop study from existing databases and conduct a site visit to verify the habitat requirements and condition of the habitat. If any rare or endangered species are discovered in the desktop study that will be negatively influenced by the proposed development, specialist surveys will be conducted.

4.3.2 Results of desktop survey and site visits during July 2021

A survey was conducted during July 2021 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the quarter degree grid.

The number of mammal species supported by a plant community depends on several factors like the primary production, seasonal availability of resources, floral heterogeneity, diversity of plant structure, nature of the substratum and previous history (Delany, 1982). Each mammal species has a particular niche, which can be regarded as the sum of all ecological requirements of a species namely food, space, shelter, and physical conditions. Mills & Hes (1997) stated that the distribution and abundance of animal species does not rigorously follow that of plant communities or biomes. Instead, mammal species seem to have certain preferences for a specific habitat type (Skinner & Smithers, 1990). Several authors have shown this preference of mammals to certain habitats through analysis (Beardall et al. 1984; Ben-Shahar, 1991; Dekker et al. 1996). The area represents a diverse vegetation structure and height class. A detailed species list for the fauna of the area is included in Appendix C, D and E.

4.3.3 Fauna habitats of the project area

Five major fauna habitats were observed in the area namely:

- Grassland.
- Microphyllous woodland (including riparian woodland).
- Open water habitats / wetlands.

- Croplands.
- Exotic bushclumps.

4.3.4 Common fauna documented and potentially occurring on the development site

4.3.4.1 Mammals

Much of the large and medium-sized mammal fauna that previously occurred on the project site is now locally extinct or occurs in small, fragmented populations in reserves. Most of the habitat types are fragmented. Therefore, the expected mammalian richness on these areas is considered low, although slightly higher richness values are expected from the more intact grassland, woodland and wetland habitats.

The Highveld Ecoregion contains a higher number of mammals, although only the orange mouse (*Mus orangiae*) is restricted to the ecoregion, and the rough-haired golden mole (*Chrysospalax villosa*) is near-endemic. The ecoregion also supports populations of several large mammal species, some of which are rare in southern Africa (Stuart and Stuart 1995). Among these are the brown hyena (*Hyaena brunnea*), African civet (*Civettictis civetta*), leopard (*Panthera pardus*), pangolin (*Manis temminckii*), honey badger (*Mellivora capensis*), striped weasel (*Poecilogale albinucha*), aardwolf (*Proteles cristatus*), oribi (*Ourebia ourebi*), and mountain zebra (*Equus zebra hartmannae*).

Predators that still roam freely in the area include larger predators such brown hyena, while smaller predators such as caracal, serval and honey badger are common throughout the larger area. Antelope species such as duiker and steenbok will roam freely through the area and are not restricted by game fences. Smaller mammal species such as honey badgers and serval can become habituated to anthropogenic influences, while other species such as brown hyena will rather move away from the construction activities and will seldom use the area.

The wetland features are an important habitat and dispersal corridor for moisture-reliant small mammals. The conservation of the wetland features and associated 32m buffer zone will conserve the moisture reliant African marsh rat (Near Threatened) within the power line corridor and act as a movement corridor for small mammals.

The connectivity1 of the corridor to the remainder of the larger area is Moderate due to other surrounding areas representing natural grassland and drainage channels. Of significance is the role of the channels and riparian zone as zoogeographical dispersal corridors.

Most mammal species are highly mobile and will move away during construction of the powerline. The most important corridors that need to be preserved for free-roaming mammal species in the area include the riparian zones, wetlands and indigenous grasslands.

1 C**onnectivity (habitat connectivity)** - Allowing for the conservation or maintenance of continuous or connected habitats, to preserve movements and exchanges associated with the habitat.

4.3.4.2 Birds (avifauna)

Bird species richness is relatively high within the Highveld Ecoregion (Harrison et al. 1997). However, Botha's lark (*Spizocorys fringillaris*) is the only bird species strictly endemic to the ecoregion, where it inhabits heavily grazed grassland. An additional six species of birds are near-endemics including whitewinged flufftail (*Sarothrura ayresii*), blue korhaan (*Eupodotis caerulescens*), southern whitebellied korhaan (*Eupodotis cafra*), Rudd's lark (*Heteromirafra ruddi*), melodious lark (*Mirafra cheniana*), buff-streaked chat *(Oenanthe bifasciatai*), and yellow-breasted pipit (*Hemimacronyx chloris*) (Harrison et al. 1997).

Many grassland birds, several of which are endemic to southern Africa, show a clear preference for sour over sweet and mixed grassland, and some of these are essentially absent from the last two grassland types, e.g. Bald Ibis, Redwing Francolin, Blackwinged Plover, Rudd's Lark, Botha's Lark, Blue Swallow, Buffstreaked Chat, Palecrowned Cisticola and Yellowbreasted Pipit. Examples of grassland species preferring sweet and mixed grasslands appear fewer but include Melodious Lark and South African Cliff Swallow. The extensive human pressures on the grassland biome have severe conservation implications for its avifauna: many of the globally threatened species present on the mainland of South Africa, Lesotho and Swaziland have major strongholds in the grassland biome and five of these (Bald Ibis, Whitewinged Flufftail, Rudd's and Botha's larks, and Yellowbreasted Pipit) are entirely restricted to this biome in the region.

The degraded grassland and cultivated land occur throughout the corridor. Bird species such as crowned plovers, crested guineafowls, francolin species as well as the birds of prey the smaller bird species attract utilize these areas. Although this microhabitat is in a degraded state, the area is a popular habitat for bird species, especially as foraging area, while species such as crowned plover and other smaller non-passerine birds also breed on the ground in this area.

There is a long list of red data bird species that have a geographical distribution that includes the wetlands associated with the corridor. The presence of the habitat of these species is mostly confined to the open water habitat and moist grassland observed on site, although the probability of finding these species in degraded habitats is very low in general.

More than 250 bird species have been recorded in the project area and surroundings. Globally threatened species include Secretarybird and Black-winged Pratincole. Congregatory birds are Egyptian Goose, Western Cattle Egret, Spur-winged Goose, South African Shelduck, Cape Shoveler and African Spoonbill.

According to Birdlife South Africa, the study area falls outside of any Important Bird Areas (IBA), identified within South Africa (www.birdlife.org.za). The conservation status of many of the bird species that are dependent on wetlands reflects the critical status of wetlands nationally, with many having already been destroyed. In the powerline corridor, man-made dams represent wetland areas.

4.3.4.3 Herpetofauna (Reptiles and Amphibians)

Twenty-nine amphibians occur within the ecoregion, but none are endemic (Passmore and Carruthers 1995). Breeding habitat of frogs and toads can be found mostly in the permanent wet zone of the wetlands and dams in the larger area. Amphibian species potentially occurring in the larger area include Common River Frog, Natal Sand Frog, Gutteral Toad, Raucous Toad and Bubbling Kassina. These species are non-threatened and widespread, and as such the development will not have any impact on amphibian conservation within the region. The wetlands could provide habitat for the red listed giant bullfrog, and therefore the 32 meter buffer zone surrounding the wetland features should be adhered to.

Relatively few reptile species occur within the Highveld Ecoregion, mainly due to its cool climate. However, the ecoregion supports some of Africa's most characteristic reptile species, including Nile crocodile (*Crocodylus niloticus*), African rock-python (*Python sebae*), water monitor (*Varanus niloticus*) and veld monitor (*Varanus exanthematicus albigularis*). There are also two strict endemic reptiles: giant girdled lizard (*Cordylus giganteus*), and *Agama distanti* (Branch 1998). Several additional reptile species are near-endemics, including Drakensberg rock gecko (*Afroendura niravia*), giant spinytail lizard (*Cordylus giganteus*), and Breyer's whiptail (*Tetrodactylus breyeri)* (Branch 1998).

In the presence of dead termitaria, the small geckos listed are probably found on the site. A few terrestrial lizards (Yellow-throated Plated Lizard, Variegate Skink), typical for Highveld Grassveld, are expected to be present. A variety of smaller snake species characteristic for Highveld Grassveld will be present (Common Wolf Snake, Brown House Snake), although some might be dependent on by the presence of dead termitaria. The only venomous snakes, which has been reported as being present and common, is as expected, the Rinkhals, Mozambique spitting cobra, snouted cobra and the Puffadder for this QDS. All the reptile species are common and widespread, and as such the development will not have any impact on reptile conservation within the region. The sungazer lizard occurs in some of the grassland areas, while the southern spiny agama and the striped harlequin snake may occur in small numbers in suitable habitat.

4.3.5 Species of Conservation Concern (SCC)

According to the existing databases and field survey the following number of fauna species included in the IUCN red data lists can potentially be found in the study area (Table 7):

Table 7. Red data list of potential fauna for the study area

English Name	Conservation Status	Probability of occurrence on site
BIRDS		
Stork, Abdim's	Near Threatened	Moderate
Stork, Yellow-billed	Endangered	Moderate
Secretarybird	Vulnerable	Moderate
MAMMALS		

English Name	Conservation Status	Probability of occurrence on site
Oribi	Endangered	Low
Roan Antelope	Endangered (2016)	Zero – restricted to game reserves
African wild dog	Endangered (2016)	Zero – restricted to game reserves
Vaal Rhebok	Near Threatened (2016)	Low
Southern African Hedgehog	Near Threatened (2016)	Moderate
Lechwe	Near Threatened (2017)	Zero – restricted to game reserves
(Southern African) Tsessebe	Vulnerable (2016)	Zero – restricted to game reserves
Sable antelope	Vulnerable (2016)	Zero – restricted to game reserves
Ground Pangolin	Vulnerable (2016)	Low
African White-tailed Rat	Vulnerable (2016)	Moderate
Hartmann's Mountain Zebra	Vulnerable A3bcd (IUCN, 2019)	Zero – restricted to game reserves
HERPETOFAUNA		
Giant Bull Frog	Near Threatened	Moderate
Giant Girdled Lizard	Vulnerable (SARCA 2014)	Low

The following impacts might occur during the development phase on the fauna populations of the area:

- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species through habitat loss or fragmentation.
- Disturbance of remnant terrestrial wild mammal, avian, amphibian and insect fauna would probably occur through physical habitat destruction, noise, traffic, and movement of people.
- Potential increase in feral animals and impact on indigenous fauna e.g., cats, rats.
- Illegal hunting or disturbance.

The following management measures are proposed regarding the conservation of these and other fauna which might occur on the property:

- The development would not have a significant impact on the above-mentioned red data fauna since adequate and natural habitat/vegetation would be available on the peripheral grassland and woodland habitats surrounding the power line. The most probable habitat to find any of the red data species in the study area would be in the more natural areas of the outcrops, grassland and wetlands where little or no disturbances form humans or livestock occur at a regular interval. Fauna will therefore rather move away from the area and utilise adjacent, more natural areas. The importance to preserve the riparian habitat should still be considered a high priority though.
- The removal of vegetation should be confined to the footprints of the proposed powerline. This will be on small sections in relation to the total available surrounding habitat for fauna. Development also will not influence the natural feeding and

movement patterns of the existing fauna in the area.

- If one considers the habitat descriptions of the red data species, most of them are not directly threatened by habitat loss. The impact of development on the red data species would therefore be less than predicted.
- The protection of different habitat types in the area will be important to ensure the survival of the different animals due to each species' individual needs and requirements. Sufficient natural corridor sections should be protected around the proposed development footprint to allow fauna to move freely between the different vegetation units on the property. The drainage channels and sections of natural vegetation will be preserved as corridors in the area and mitigation measures should be implemented to ensure that the habitats are protected.
- The taller (>3m) indigenous trees within this area also provide resting/perching sites for larger birds like birds of prey, arboreal reptiles and mammals that might occur/pass through the area and should preferably be preserved. These larger trees should be protected as far as possible and be incorporated into the proposed development. The removal of large dead trees is also not advised as these trees also provide smaller habitats for rodents. The grass layer on the other hand also provides a valuable food source (insects, reptiles, small mammals that occur in/on the grass layer) for fauna.
- A monitoring programme needs to be implemented by a specialist if any rare species are confirmed on the property.

The following practical recommendations with regards to the fauna of the area apply with regards to the construction of the proposed development:

- Where trenches pose a risk to animal safety during construction, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling of trenches during the construction.
- No animals may be poached. Many animals are protected by law and poaching, or other interference could result in a fine or jail term.
- Do not feed any wild animals on site.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Walkways and roads should be designed without vertical pavements to allow for the movement of small mammals.
- Waste bins and foodstuffs should be made scavenger proof.

- Monitoring of the environmental aspects is recommended for the future phases of the proposed development should the authorities approve the application. The monitoring phase would ensure that negative impacts on the fauna and flora of the area are limited to a minimum during the construction phase.

4.3.5.1 EIA screening tool listed species (SCC)

Table 8 indicate the listed fauna species for the project area according to the EIA screening tool:

Table 8. Listed fauna for the project area according to the EIA screening tool, status, and habitat.

Species	Status	Habitat
Hydrictis maculicollis (Spotted necked otter)	Near Threatened	These otters are aquatic and require permanent and continuous waterways. They prefer clear water with rocks. They are found in lakes, swamps, rivers, and may be found in mountain streams at higher elevations. They are absent in turbid rivers and shallow alkaline lakes. They live in dens, which are found near these sources of water.

4.3.5.1.1 Spotted Necked Otter

The spotted-necked otters are in decline due to changes in their environment and human interference. One problem is the increased use of nylon fishing nets, in which the otters get tangled in and die. Erosion of soil near the source of the rivers is also a threat. Fish-farmers and fur-trappers are also playing a part in the decline of the spotted-necked otter.

The species is found in central Africa south of 10 degrees N latitude. They are abundant in both Lake Victoria and the Lakes Tangangyika and may be found in the moister parts of sub-Saharan Africa. They are not found in the far west, southwest, northeast, or east regions of Africa.

These otters are aquatic and require permanent and continuous waterways. They prefer clear water with rocks. They are found in lakes, swamps, rivers, and may be found in mountain streams at higher elevations. They are absent in turbid rivers and shallow alkaline lakes. They live in dens, which are found near these sources of water.

Probability of occurrence on site: Low probability of occurring on site due to large home ranges and limited habitats.

Probability of impact during vegetation clearance: Low, the potential habitat will not be impacted on by the proposed development**.**

5 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE FAUNA AND FLORA

An environmental impact is defined as a change in the environment, be it the physical/chemical, biological, cultural and or socio-economic environment. Any impact can be related to certain aspects of human activities in this environment and this impact can be either positive or negative. It could also affect the environment directly or indirectly and the effect of it can be cumulative. There are three major categories of impacts on biodiversity namely:

- Impacts on habitat resulting in loss, degradation and / or fragmentation.
- Direct impacts on fauna and flora and species, for example plants and animals that are endemic / threatened / special to a habitat will not be able to survive if that habitat is destroyed or altered by the development.
- Impact on natural environmental processes and ecosystem functioning. This can lead to an accumulated effect on both habitat and species.

This biodiversity assessment focused on the description of ecosystem- and species-related biodiversity. It can be expected that if ecosystem diversity is managed effectively, species and genetic diversity should also be protected. Emphasis was therefore placed on the ecosystem diversity (landscape/habitat types) within the proposed development area / power line corridor, with reference to biota observed and expected to utilise these landscapes or habitat types.

5.1 POTENTIAL IMPACTS

5.1.1 Direct habitat destruction

5.1.1.1 Description of impact:

The construction phase of the development and associated infrastructure will result in loss of and damage to natural habitats if the vegetation is cleared for the development of the powerline. Rehabilitation of some areas would be possible but there is likely to be long-term damage in large areas. Most habitat destruction will be caused during the construction phase. However, re-growth of grass and dwarf shrubs under the powerline will take place. The areas below the powerline in grassland will have to be cleared (slashed) of excess vegetation at regular intervals to allow access to the area for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the power line conductors and to minimize the risk of fire which can result in electrical flashovers. These activities will have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat.

The impact of powerline and specific placement of the poles should be restricted to the proposed line and not over the larger area.

Vegetation communities are likely to be impacted on a small spatial scale in comparison to the extent of the vegetation communities' total area in the region.

The impact of the habitat destruction will be on the flora and fauna of the study area in the following ways:

- The construction will lead to the loss of individual plants such as grasses, forbs, trees, and shrubs that will be cleared on the footprint area. This will mostly occur during the construction phase.
- Loss of threatened, near-threatened and endemic taxa: The anticipated loss of some of the natural habitats that support endemic species will result in the local displacement of endemic listed flora.
- Due to habitat loss and construction activities animals will migrate from the construction area and animal numbers will decrease.
- Loss of threatened, “near-threatened” and conservation important taxa: The anticipated loss of the natural woodland will result in the local displacement of some fauna species. In some cases, isolated populations of threatened fauna might be removed from the area, although no such populations or knowledge thereof was found in the study area. This impact could also take place because of hunting and snaring of animals in natural areas not used for the powerline.
- Changes in the community structure: It is expected that the faunal species composition will shift, due to an anticipated loss in habitat surface area. In addition, it is predicted that more generalist species (and a loss of functional guilds) will dominate the study area. Attempts to rehabilitate will attract taxa with unspecialized and generalist life-histories. It is predicted that such taxa will persist for many years before conditions become suitable for succession to progress.

5.1.1.2 Mitigation measures:

- The removal of indigenous flora should be kept to a minimum necessary. Trim, rather than fell of woody species along the edges of the development site where possible. The clearing and damage of plant growth in the riparian and wetland areas should be restricted to the actual crossing where possible, and not into the sensitive adjacent areas. Where protected flora will need to be cleared or pruned, permits should be obtained from the relevant authority.
- Peripheral impacts around the development corridor on the surrounding vegetation of the area should be avoided and a monitoring programme should be implemented to ensure the impacts are kept to a minimum, while the rehabilitation of the power line route should be prioritized after construction has been completed.
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.

- An avifauna specialist should be consulted to conduct a specialist study for the project area and monitoring of the potential impact of the powerline in the future.
- All development activities should be restricted to specific recommended areas. The Environment Control Officer (ECO) should control these areas. Storage of equipment, fuel and other materials should be limited to demarcated areas. Layouts should be adapted to fit natural patterns rather than imposing rigid geometries. The entire development footprint should be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This would only be applicable to the construction phase of the proposed development.
- The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation.
- Where holes for poles pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling during planting of the poles along the lines.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna and flora of the area.
- Placement of pylons should be outside sensitive vegetation units, outcrops and drainage channels and wetlands (including the 32m buffer).
- A detailed wetland assessment should be conducted to determine the exact edges of potential wetlands and drainage channels.

5.1.2 Habitat fragmentation

5.1.2.1 Description of impact:

The construction of the powerline development and associated infrastructure will result in natural movement patterns being disrupted for a limited period and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations, although the impact will be minimal and restricted to the construction phase.

5.1.2.2 Mitigation measures:

- Use existing facilities (e.g., impacted areas) to the extent possible to minimize the amount of new disturbance.
- Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the sensitive features such as surrounding woodland and riparian woodland outside the project area during construction.
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- Construction activities must remain within defined construction areas. No construction / disturbance will occur outside these areas.

5.1.3 Increased Soil erosion and sedimentation

5.1.3.1 Description of impact:

The construction activities associated with the development may result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil erosion promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous flora.

5.1.3.2 Mitigation measures:

The following mitigation measures should be implemented to prevent erosion during construction:

- The project should be divided into as many phases as possible, to ensure that the exposed areas prone to erosion are minimal at any specific time.
- Cover disturbed soils as completely as possible, using vegetation or other materials.
- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices.
- Protect sloping areas and drainage channel banks that are susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas.
- Repair all erosion damage as soon as possible to allow for sufficient rehabilitation growth.

- Gravel roads to the construction sites must be well drained to limit soil erosion.
- Control the flow of runoff to move the water safely off the site without destructive gully formation.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas.
- Placement of pylons should be outside sensitive soil types and drainage channels.

5.1.4 Soil and water pollution

5.1.4.1 Description of impact:

Construction work for the proposed development will always carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on fauna and flora. During the constructional phase heavy machinery and vehicles would be the main contributors to potential pollution problems.

5.1.4.2 Mitigation measures:

- Any excess or waste material or chemicals should be removed from the site and discarded in an environmentally friendly way. The ECO should enforce this rule rigorously.
- Hazardous chemicals to be stored on an impervious surface protected from rainfall and storm water run-off.
- Spill kits should be on-hand to deal with spills immediately.
- All vehicles should be inspected for oil and fuel leaks on a regular basis. Vehicle maintenance yards on site should make provision for drip trays that will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

5.1.5 Air pollution

5.1.5.1 Description of impact:

The environmental impacts of wind-borne dust, gases and particulates from the construction activities associated with the proposed development are primarily related to human health and ecosystem damage. The proposed development will typically comprise the following sources and associated air quality pollutants:

- Materials handling operations (truck loading & unloading, tipping, stockpiling).

- Vehicle entrainment on paved and unpaved roads.
- Windblown dust-fugitive emissions.

One of the primary impacts on the biophysical environment is linked to emission of dusts and fumes from the transportation system. Dust pollution will impact the most severe during the construction phase. Construction vehicles and equipment are the major contributors to the impact on air quality. Dust is generated during site clearance for the construction of infrastructure. Diesel exhaust gasses and other hydrocarbon emissions all add to the deterioration in air quality during this phase. Vehicles travelling at high speeds on dirt roads significantly aggravate the problem.

Although the potential for severe fugitive dust impacts is greatest within 100 m of the dust-generating activities, there is still the potential for dust to affect vegetation up to five kilometres or more downwind from the source. Dust deposited on the ground may cause changes in soil chemistry (chemical effects) and may over the long-term result in changes in plant chemistry, species composition and community structure. Sensitivities to dust deposition of the various plant species present in the area are not known. It is therefore difficult to predict which species may be susceptible.

Poor air quality results in deterioration of visibility and aesthetic landscape quality of the region, particularly in winter due to atmospheric inversions.

5.1.5.2 Mitigation measures:

- A speed limit should be enforced on dirt roads (preferably 30-40km/h).
- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.

5.1.6 Spread and establishment of alien invasive species

5.1.6.1 Description of impact:

Continued movement of vehicles on and off the site during the construction phase will result in a risk of importation of alien species. Vehicles often transport many seeds, and some may be of invader species, which may become established along the access road, especially where the area is disturbed. The construction phase carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

5.1.6.2 Mitigation measures:

- Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Weeds and invader plants will be controlled in the manner prescribed for that category by the CARA or in terms of Working for Water guidelines. The control of these species should even begin prior to the construction phase considering that small populations of these species was observed during the field surveys.
- Institute strict control over materials brought onto site, which should be inspected for seeds of noxious plants and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual herbicides prior to transport to or in a quarantine area on site. The contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase. Alien invasive tree species listed by the CARA regulations should be eradicated.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds. Once detected, an eradication/control programme should be implemented to ensure that the species' do not spread to surrounding natural ecosystems.

5.1.7 Negative effect of human activities and road mortalities

5.1.7.1 Description of impact:

An increase in human activity on the site and surrounding areas is anticipated. The risk of snaring, killing, and hunting of certain faunal species is increased. If staff compounds are erected for construction workers, the risk of pollution because of litter and inadequate sanitation and the introduction of invasive fauna and flora are increased. The presence of many construction workers or regular workers during the construction phase on site over a protracted period will result in a greatly increased risk of uncontrolled fires arising from cooking fires, improperly disposed cigarettes etc.

Large numbers of fauna are also killed daily on roads. They are either being crushed under the tyres of vehicles in the case of crawling species, or by colliding with the vehicle itself in the case of avifauna or flying invertebrates. The impact is intensified at night, especially for flying insects, as result of their attraction to the lights of vehicles.

5.1.7.2 Mitigation measures:

- No staff should be accommodated on the site. If practical, construction workers should stay in one of the nearby villages / towns and transported daily to the site.
- The ECO should regularly inspect the site, including storage facilities and compounds

and eradicate any invasive or exotic plants and animals.

- Maintain proper firebreaks around entire development footprint.
- Educate construction workers regarding risks and correct disposal of cigarettes.
- More fauna is normally killed the faster vehicles travel. A speed limit should be enforced (preferably 40 km/hour). It can be considered to install speed bumps in sections where the speed limit tends to be disobeyed. (Speed limits will also lessen the probability of road accidents and their negative consequences).
- Travelling at night should be avoided or limited as much as possible.

5.2 IMPACT ASSESSMENT MATRIX

Table 9 indicate the impacts described above and specific ratings of significance the development impact will potentially have on the ecological components of the study area.

Table 9. Impact assessment Matrix for the proposed development

Nr	Activity	Impact	Without or With Mitigation	Nature (Negative or Positive Impact)	Probability		Duration		Scale		Magnitude/ Severity		Significance		Mitigation Measures	Mitigation Effect
					Magnitude	Score	Magnitude	Score	Magnitude	Score	Magnitude	Score	Score	Magnitude		
Terrestrial Biodiversity Impact Assessment																
Construction Phase																
1	Clearing of vegetation for construction of infrastructure, access roads etc.	Habitat destruction & Fragmentation	**WOM**	Negative	Definite	5	Permanent	5	Local	1	Medium	8	70	High	Refer to Sections 5.1.1.2 and 5.1.2.2	May cause irreplaceable loss of resources
			WM	Negative	Definite	5	Permanent	5	Local	1	Low	6	60	Moderate		
2	Topsoil & subsoil stripping, exposure of soils to wind and rain during construction causing erosion and sedimentation in wetlands	Soil erosion and sedimentation	**WOM**	Negative	Definite	5	Permanent	5	Regional	3	High	8	80	High	Refer to section 5.1.3.2	Can be reversed
			WM	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate		
3	Exposure of soils to rainfall and wind during construction	Dust pollution	**WOM**	Negative	Definite	5	Medium term	3	Site	2	Medium	6	55	Moderate	Refer to section 5.1.4.2	Can be reversed
			WM	Negative	Highly Probable	5	Medium term	3	Site		Low	2	25	Low		
4	Heavy machinery and vehicle movement on site	Spillages of harmful substances	**WOM**	Negative	Highly Probable	4	Long term	4	Regional	3	Medium	6	52	Moderate	Refer to section 5.1.5.2	Can be avoided, managed, or mitigated
			WM	Negative	Probable	2	Long term	4	Site	2	Low	2	16	Negligible		
5	Continued movement of personnel and vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance	Spreading of alien invasive species	**WOM**	Negative	Highly Probable	4	Permanent	5	Site	2	Medium	6	52	Moderate	Refer to section 5.1.6.2	Can be reversed
			WM	Negative	Probable	2	Medium term	3	Site	2	Low	2	14	Negligible		
6	Construction of infrastructure, access roads etc.	Negative effect of human activties on fauna and flora	**WOM**	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate	Refer to section 5.1.7.2	Can be avoided, managed, or mitigated
			WM	Negative	Probable	2	Medium term	3	Site	2	Low	2	14	Negligible		
7	Continued movement of vehicles on and off the site during the construction phase, as well as occasional delivery of materials required for maintenance	Road mortalities of fauna	**WOM**	Negative	Highly Probable	4	Medium term	3	Site	2	Medium	6	44	Moderate	Refer to section 5.1.8.2	Can be avoided, managed, or mitigated
			WM	Negative	Highly Probable	4	Medium term	3	Site	2	Low	2	28	Low		

6 ECOLOGICAL SENSITIVITY CLASSES

Following the ecological surveys, the classification of the study area into different sensitivity classes and development zones was based on information collected at various levels on different environmental characteristics. Factors which determined sensitivity classes were as follows:

- Presence, density and potential impact of development on rare, endemic and protected plant species.
- Conservation status of vegetation units.
- Soil types, soil depth and soil clay content.
- Previous land-use.
- State of the vegetation in general as indicated by indicator species.

Below included is the sensitivity map for the proposed powerline development, (Figure 15). Only criteria applicable to the specific vegetation units were used to determine the sensitivity of the specific unit. Specific mitigation should be implemented around wetlands and drainage features in the area to prevent negative impacts (i.e. implementation of a 32m no-go buffer), while an avifauna specialist study should be conducted for the powerline development.

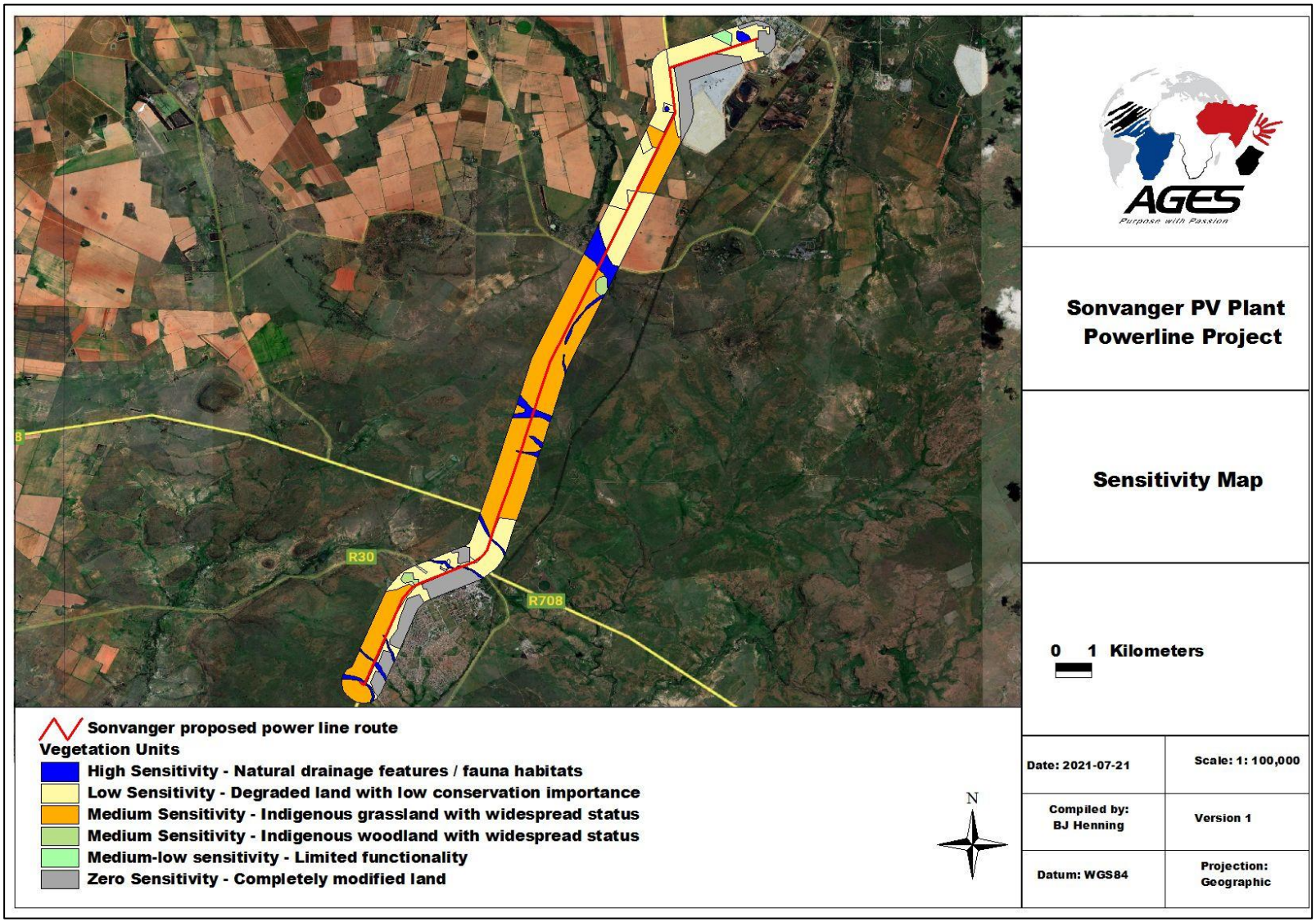

Figure 15. Sensitivity Map of the project area

7 DISCUSSION

Following the investigation and potential ecological impact of the proposed powerline development on the biodiversity (including plant and animal species theme) of the area, the following conclusions are drawn:

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. The proposed development activities will modify the vegetation and faunal habitats of the development site /power line corridor to a certain extent varying according to the habitats on the site, although in general the vegetation on site where the development footprint is planned are classified slightly degraded to completely modified.

Most sensitive sections: It is evident from the distribution of biodiversity, presence of threatened species and sites of scientific interest, that the proposed development has the potential for negative impact on the flora and faunal of the study area. This is particularly true of the sensitive vegetation associated with the riverine and wetland ecosystems and the project area.

Most sensitive habitats: Many fauna threatened species are grassland and riparian specialists, linked to these habitats either for breeding, feeding or shelter. Major impacts on riverine areas should be avoided wherever possible during construction. Where unavoidable impacts will occur on grassland and riparian zones, strict mitigation measures and legislation should be implemented (licence for eradication of protected plants, IWUL application etc.).

Monitoring of threatened species: Many endemic and protected species have been recorded in region. The EMP for the development should highlight the conservation status of these species and note that steps must be undertaken in conjunction with conservation authorities to protect or translocate any populations encountered during project actions. Ecological monitoring is recommended for the construction phase of the development considering the presence of protected trees and potential red data fauna on areas surrounding the site.

The importance of rehabilitation and implementation of mitigation processes to prevent negative impacts on the environment during and after the construction phase of the powerline should be considered a high priority. The proposed site for the development varies from being in a completely modified to slightly degraded state.

A sensitivity analyses was conducted to identify the most suitable site for the development. From this investigation and ecological surveys, the following main observations was made:

- Most of the natural grassland and microphyllous woodland have a Medium Sensitivity and development can be supported in the area provided certain mitigation measures are implemented. Where the clearance of the vegetation would cause protected plants or other fauna to be removed, permits should be

obtained from the relevant authorities.

- The wetlands (including valley bottoms and pans) and riparian zones have a high sensitivity and should be preserved as important fauna and flora habitats. The appropriate buffer needs to be applied.
- The degraded grasslands and exotic bushclumps have a low sensitivity.

Some potential rare fauna may also occur in the area, and specific mitigation measures need to be implemented to ensure that the impact of the development on the species' habitat will be low. Specific mitigation relating to red data fauna includes the following:

- Disturbances in close vicinity of the development (periphery) should be limited to the smallest possible area to protect species habitat.
- Corridors are important to allow fauna to move freely between the areas of disturbance.
- Specific mitigation should be implemented around wetlands and drainage features in the area to prevent negative impacts, while an avifauna specialist study should be conducted for the powerline development.

Several potential impacts were identified and assessed. A few of these were assessed as having potentially medium or high significance, including the following:

- Destruction or disturbance to sensitive ecosystems leading to reduction in the overall extent of a particular habitat.
- Increased soil erosion.
- Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts.
- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species.
- Soil and water pollution through spillages.
- Establishment and spread of declared weeds and alien invader plants.
- Impacts of human activities on fauna and flora of the area during construction.
- Air pollution through dusts and fumes from construction vehicles (construction phase)

Mitigation measures are provided that would reduce these impacts from a higher to a lower significance, which will then allow for an acceptable level of impact. Furthermore, the proposed layout plan of the development should be consistent with the sensitivity map and recommendations stipulated in this report, and the impact on the sensitive habitats on site should be kept to a minimum.

8 CONCLUSION

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. If we can bring about a more integrated approach to living within our ecosystems, we are much more likely to save the fundamental structure of biodiversity. Positive contributions can be made even on a small scale such as within the proposed powerline development. All stakeholders, such as business, government and environmental groups need to be involved to the impacts associated with the development from causing a significant loss.

The proposed development should avoid sensitive areas such as wetlands and riverine areas where possible (placement of pylons outside areas and specialist avifauna impacts for potential impacts on avifauna), while also allowing corridors of indigenous grassland on areas outside the development footprint to be preserved. Where sensitive areas of natural vegetation cannot be avoided, a few mitigation measures have been recommended to minimise and/or offset impacts (licence application for eradication of protected species, relocation of rare species). Negative impacts can be minimised by strict enforcement and compliance with an Environmental Management Plan which considers the recommendations for managing impacts detailed above.

Provided that the proposed development and layout plan is consistent with the sensitivity map and take all the mitigation measures into consideration stipulated in this report, the planned development can be supported.

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APPENDIX A. PLANT SPECIES IN QDS

Family	Species	IUCN	Ecology
Asteraceae	*Arctotis stoechadifolia*	LC	Indigenous; Endemic

Family	Species	IUCN	Ecology
Ricciaceae	*Riccia simii*		Indigenous
Aizoaceae	*Ruschia sp.*		
Poaceae	*Aristida congesta*	LC	Indigenous
Menispermaceae	*Antizoma angustifolia*	LC	Indigenous
Poaceae	*Eragrostis lehmanniana*	LC	Indigenous
Scrophulariaceae	*Chaenostoma patrioticum*	LC	Indigenous
Convolvulaceae	*Convolvulus sagittatus*	LC	Indigenous
Fabaceae	*Indigofera alternans*	LC	Indigenous
Poaceae	*Urochloa panicoides*	LC	Indigenous
Poaceae	*Setaria sphacelata*	LC	Indigenous
Lobeliaceae	*Cyphia triphylla*	LC	Indigenous
Crassulaceae	*Kalanchoe thyrsiflora*	LC	Indigenous
Poaceae	*Eragrostis nindensis*	LC	Indigenous
Convolvulaceae	*Seddera capensis*	LC	Indigenous
Asteraceae	*Nolletia ciliaris*	LC	Indigenous
Asteraceae	*Osteospermum scariosum*	NE	Indigenous
Asteraceae	*Tarchonanthus camphoratus*	LC	Indigenous
Poaceae	*Microchloa caffra*	LC	Indigenous
Polygonaceae	*Rumex lanceolatus*	LC	Indigenous
Fabaceae	*Vachellia karroo*	LC	Indigenous
Poaceae	*Eragrostis curvula*	LC	Indigenous
Scrophulariaceae	*Chaenostoma neglectum*	LC	Indigenous
Asteraceae	*Helichrysum pumilio*	LC	Indigenous; Endemic
Myrsinaceae	*Myrsine africana*	LC	Indigenous
Poaceae	*Eragrostis stapfii*	LC	Indigenous
Poaceae	*Aristida congesta*	LC	Indigenous
Amaryllidaceae	*Boophone disticha*	LC	Indigenous
Verbenaceae	*Verbena bonariensis*		Not indigenous; Naturalised; Invasive
Poaceae	*Cynodon dactylon*	LC	Indigenous
Tamaricaceae	*Tamarix chinensis*		Not indigenous; Naturalised; Invasive
Asteraceae	*Geigeria aspera*	LC	Indigenous
Solanaceae	*Solanum campylacanthum*		Indigenous
Amaranthaceae	*Atriplex suberecta*	LC	Not indigenous; Naturalised; Invasive
Cyperaceae	*Cyperus semitrifidus*	LC	Indigenous
Iridaceae	*Duthieastrum linifolium*	LC	Indigenous; Endemic
Crassulaceae	*Crassula corallina*	LC	Indigenous
Lamiaceae	*Salvia stenophylla*		Indigenous
Poaceae	*Brachiaria serrata*	LC	Indigenous
Amaryllidaceae	*Nerine laticoma*	LC	Indigenous
Poaceae	*Eragrostis superba*	LC	Indigenous
Campanulaceae	*Wahlenbergia androsacea*	LC	Indigenous
Convolvulaceae	*Ipomoea simplex*	LC	Indigenous
Santalaceae	*Viscum rotundifolium*	LC	Indigenous
Cyperaceae	*Cyperus marginatus*	LC	Indigenous
Poaceae	*Cymbopogon pospischilii*	NE	Indigenous
Poaceae	*Aristida canescens*	LC	Indigenous

Family	Species	IUCN	Ecology
Solanaceae	*Lycium arenicola*	LC	Indigenous
Zygophyllaceae	*Tribulus terrestris*	LC	Indigenous
Asteraceae	*Aster sp.*		
Poaceae	*Heteropogon contortus*	LC	Indigenous
Poaceae	*Themeda triandra*	LC	Indigenous
Poaceae	*Eustachys paspaloides*	LC	Indigenous
Crassulaceae	*Crassula tabularis*	LC	Indigenous
Verbenaceae	*Glandularia aristigera*		Not indigenous; Naturalised; Invasive
Pottiaceae	*Trichostomum brachydontium*		Indigenous
Solanaceae	*Cestrum aurantiacum*		Not indigenous; Naturalised; Invasive
Poaceae	*Brachiaria nigropedata*	LC	Indigenous
Asteraceae	*Berkheya onopordifolia*	LC	Indigenous
Orobanchaceae	*Striga sp.*		
Asphodelaceae	*Trachyandra asperata*	LC	Indigenous
Aizoaceae	*Chasmatophyllum musculinum*	LC	Indigenous
Juncaceae	*Juncus rigidus*	LC	Indigenous
Ebenaceae	*Diospyros lycioides*	LC	Indigenous
Verbenaceae	*Chascanum pinnatifidum*	LC	Indigenous
Scrophulariaceae	*Gomphostigma virgatum*	LC	Indigenous
Poaceae	*Oropetium capense*	LC	Indigenous
Poaceae	*Aristida diffusa*	LC	Indigenous
Salicaceae	*Salix babylonica*		Not indigenous; Naturalised
Aizoaceae	*Ruschia rigens*	LC	Indigenous; Endemic
Poaceae	*Elionurus muticus*	LC	Indigenous
Asteraceae	*Hypochaeris microcephala*		Not indigenous; Naturalised
Orchidaceae	*Eulophia hians*	LC	Indigenous
Anacampserotaceae	*Anacampseros ustulata*	LC	Indigenous; Endemic
Fabaceae	*Lessertia frutescens*	LC	Indigenous
Poaceae	*Tragus koelerioides*	LC	Indigenous

APPENDIX B. PLANT SPECIES FOUND ON SITE

Plant species
Woody species
Eucalyptus camaldulensis

Plant species
Vachellia karroo
Ziziphus mucronata
Vachellia tortilis
Searsia lancea
Searsia pyroides
Grass species
Anthephora pubescens
Aristida junciformes
Chloris virgata
Cymbopogon pospischilli
Cynodon dactylon
Dichanthium annulatum
Digitaria eriantha
Diplachne fusca
Eleusine coracana
Eragrostis bicolor
Eragrostis biflora
Eragrostis chloromelas
Eragrostis gummiflua
Eragrostis lehmanniana
Eragrostis plana
Fingerhutia africana
Heteropogon contortus
Hyparrhenia hirta
Hyparrhenia tamba
Imperata cylindrica
Leersia hexandra
Melinis repens
Miscanthus junceus
Panicum natalense
Panicum natalensis
Phragmites australis
Pogonarthria squarrosa
Setaria incrassatae
Setaria sphacelata
Sporobolus africanus
Themeda triandra
Trachypogon spicatus
Trichoneura grandiglumis
Triraphis andropogonoides
Urochloa mosambicensis
Urochloa panicoides
Dwarf shrubs, Forbs, geophytes & succulents

Plant species
Amaranthus spinosa
Argemone ochroleuca
Asparagus laricinus
Asparagus suaveolens
Athrixia elata
Berkheya onopordifolia
Berkheya purpurea
Berkheya rigida
Berkheya speciosa
Bidens bipinnata
Bidens pilosa
Clematis brachiata
Conyza albida
Conyza bonariensis
Cyperus obtusiflorus
Cyperus sexangularis
Datura stramonium
Felicia muricata
Hermbstaedtia linearis
Hypoxis rigidula
Indigofera daleioides
Kyling alba
Nidorella anomala
Opuntia ficus indica
Oxalis spp.
Pentzia incana
Persicaria serrulata
Persicaria serrulata
Senecio inornatus
Solanum incanum
Stoebe vulgaris
Tagetes minuta
Altenanthera pungens
Typha capensis
Vernonia oligocephala
Wahlenbergia caledonica
Xanthium strumarium
Zinnia peruviana

APPENDIX C. BIRD SPECIES LIST FOR QDS

Common_group	**Common_species**	**Genus**	**Species**
Avocet	Pied	*Recurvirostra*	*avosetta*
Barbet	Acacia Pied	*Tricholaema*	*leucomelas*

Common_group	Common_species	Genus	Species
Barbet	Black-collared	*Lybius*	*torquatus*
Barbet	Crested	*Trachyphonus*	*vaillantii*
Batis	Pririt	*Batis*	*pririt*
Bee-eater	European	*Merops*	*apiaster*
Bee-eater	White-fronted	*Merops*	*bullockoides*
Bishop	Southern Red	*Euplectes*	*orix*
Bishop	Yellow-crowned	*Euplectes*	*afer*
Bulbul	African Red-eyed	*Pycnonotus*	*nigricans*
Buzzard	Jackal	*Buteo*	*rufofuscus*
Canary	Black-throated	*Crithagra*	*atrogularis*
Canary	Yellow	*Crithagra*	*flaviventris*
Chat	Anteating	*Myrmecocichla*	*formicivora*
Chat	Familiar	*Cercomela*	*familiaris*
Cisticola	Cloud	*Cisticola*	*textrix*
Cisticola	Desert	*Cisticola*	*aridulus*
Cisticola	Levaillant's	*Cisticola*	*tinniens*
Cisticola	Zitting	*Cisticola*	*juncidis*
Cliff-swallow	South African	*Hirundo*	*spilodera*
Coot	Red-knobbed	*Fulica*	*cristata*
Cormorant	Reed	*Phalacrocorax*	*africanus*
Cormorant	White-breasted	*Phalacrocorax*	*carbo*
Crow	Pied	*Corvus*	*albus*
Cuckoo	Diderick	*Chrysococcyx*	*caprius*
Cuckoo	Red-chested	*Cuculus*	*solitarius*
Darter	African	*Anhinga*	*rufa*
Dove	Laughing	*Streptopelia*	*senegalensis*
Dove	Namaqua	*Oena*	*capensis*
Dove	Red-eyed	*Streptopelia*	*semitorquata*
Dove	Rock	*Columba*	*livia*
Duck	White-faced	*Dendrocygna*	*viduata*
Duck	Yellow-billed	*Anas*	*undulata*
Egret	Cattle	*Bubulcus*	*ibis*
Egret	Little	*Egretta*	*garzetta*
Egret	Yellow-billed	*Egretta*	*intermedia*
Falcon	Amur	*Falco*	*amurensis*
Finch	Red-headed	*Amadina*	*erythrocephala*
Finch	Scaly-feathered	*Sporopipes*	*squamifrons*
Firefinch	Red-billed	*Lagonosticta*	*senegala*
Fiscal	Common (Southern)	*Lanius*	*collaris*
Fish-eagle	African	*Haliaeetus*	*vocifer*
Flycatcher	Fiscal	*Sigelus*	*silens*
Flycatcher	Spotted	*Muscicapa*	*striata*
Goose	Domestic	*Anser*	*anser*
Goose	Egyptian	*Alopochen*	*aegyptiacus*
Goose	Spur-winged	*Plectropterus*	*gambensis*

Common_group	Common_species	Genus	Species
Goshawk	Gabar	*Melierax*	*gabar*
Grebe	Little	*Tachybaptus*	*ruficollis*
Guineafowl	Helmeted	*Numida*	*meleagris*
Gull	Grey-headed	*Larus*	*cirrocephalus*
Hamerkop	Hamerkop	*Scopus*	*umbretta*
Heron	Black-headed	*Ardea*	*melanocephala*
Heron	Goliath	*Ardea*	*goliath*
Heron	Grey	*Ardea*	*cinerea*
Heron	Purple	*Ardea*	*purpurea*
Hoopoe	African	*Upupa*	*africana*
Ibis	African Sacred	*Threskiornis*	*aethiopicus*
Ibis	Glossy	*Plegadis*	*falcinellus*
Ibis	Hadeda	*Bostrychia*	*hagedash*
Indigobird	Village	*Vidua*	*chalybeata*
Kestrel	Lesser	*Falco*	*naumanni*
Kingfisher	Brown-hooded	*Halcyon*	*albiventris*
Kingfisher	Malachite	*Alcedo*	*cristata*
Kite	Black-shouldered	*Elanus*	*caeruleus*
Korhaan	Northern Black	*Afrotis*	*afraoides*
Lapwing	Blacksmith	*Vanellus*	*armatus*
Lapwing	Crowned	*Vanellus*	*coronatus*
Lark	Rufous-naped	*Mirafra*	*africana*
Lark	Sabota	*Calendulauda*	*sabota*
Lark	Spike-heeled	*Chersomanes*	*albofasciata*
Longclaw	Cape	*Macronyx*	*capensis*
Martin	Brown-throated	*Riparia*	*paludicola*
Masked-weaver	Southern	*Ploceus*	*velatus*
Moorhen	Common	*Gallinula*	*chloropus*
Mousebird	Red-faced	*Urocolius*	*indicus*
Mousebird	Speckled	*Colius*	*striatus*
Mousebird	White-backed	*Colius*	*colius*
Myna	Common	*Acridotheres*	*tristis*
Ostrich	Common	*Struthio*	*camelus*
Palm-swift	African	*Cypsiurus*	*parvus*
Paradise-whydah	Long-tailed	*Vidua*	*paradisaea*
Pigeon	Speckled	*Columba*	*guinea*
Pipit	African	*Anthus*	*cinnamomeus*
Plover	Three-banded	*Charadrius*	*tricollaris*
Pochard	Southern	*Netta*	*erythrophthalma*
Prinia	Black-chested	*Prinia*	*flavicans*
Pytilia	Green-winged	*Pytilia*	*melba*
Quelea	Red-billed	*Quelea*	*quelea*
Robin-chat	Cape	*Cossypha*	*caffra*
Ruff	Ruff	*Philomachus*	*pugnax*
Sandpiper	Marsh	*Tringa*	*stagnatilis*

Common_group	Common_species	Genus	Species
Sandpiper	Wood	*Tringa*	*glareola*
Scimitarbill	Common	*Rhinopomastus*	*cyanomelas*
Scrub-robin	Kalahari	*Cercotrichas*	*paena*
Shelduck	South African	*Tadorna*	*cana*
Shoveler	Cape	*Anas*	*smithii*
Sparrow	Cape	*Passer*	*melanurus*
Sparrow	House	*Passer*	*domesticus*
Sparrow	Southern Grey-headed	*Passer*	*diffusus*
Sparrow-weaver	White-browed	*Plocepasser*	*mahali*
Spurfowl	Swainson's	*Pternistis*	*swainsonii*
Starling	Cape Glossy	*Lamprotornis*	*nitens*
Starling	Common	*Sturnus*	*vulgaris*
Starling	Pied	*Spreo*	*bicolor*
Starling	Wattled	*Creatophora*	*cinerea*
Stilt	Black-winged	*Himantopus*	*himantopus*
Stint	Little	*Calidris*	*minuta*
Stonechat	African	*Saxicola*	*torquatus*
Swallow	Barn	*Hirundo*	*rustica*
Swallow	Greater Striped	*Hirundo*	*cucullata*
Swallow	White-throated	*Hirundo*	*albigularis*
Swift	Little	*Apus*	*affinis*
Swift	White-rumped	*Apus*	*caffer*
Teal	Cape	*Anas*	*capensis*
Teal	Hottentot	*Anas*	*hottentota*
Teal	Red-billed	*Anas*	*erythrorhyncha*
Tern	Whiskered	*Chlidonias*	*hybrida*
Thrush	Karoo	*Turdus*	*smithi*
Tit-babbler	Chestnut-vented	*Parisoma*	*subcaeruleum*
Turtle-dove	Cape	*Streptopelia*	*capicola*
Wagtail	Cape	*Motacilla*	*capensis*
Waxbill	Blue	*Uraeginthus*	*angolensis*
White-eye	Orange River	*Zosterops*	*pallidus*
Whydah	Pin-tailed	*Vidua*	*macroura*
Whydah	Shaft-tailed	*Vidua*	*regia*
Widowbird	Long-tailed	*Euplectes*	*progne*
Wood-hoopoe	Green	*Phoeniculus*	*purpureus*

APPENDIX D MAMMAL SPECIES LIST

Family	Scientific name	Common name	Red list
Bathyergidae	*Cryptomys hottentotus*	Southern African Mole-rat	Least Concern (2016)
Bovidae	*Aepyceros melampus*	Impala	Least Concern
Bovidae	*Alcelaphus buselaphus*	Hartebeest	

Family	Scientific name	Common name	Red list
Bovidae	*Antidorcas marsupialis*	Springbok	Least Concern (2016)
Bovidae	*Connochaetes gnou*	Black Wildebeest	Least Concern (2016)
Bovidae	*Connochaetes taurinus taurinus*		Least Concern (2016)
Bovidae	*Damaliscus lunatus lunatus*	(Southern African) Tsessebe	Vulnerable (2016)
Bovidae	*Damaliscus pygargus phillipsi*	Blesbok	Least Concern (2016)
Bovidae	*Hippotragus equinus*	Roan Antelope	Endangered (2016)
Bovidae	*Hippotragus niger niger*		Vulnerable (2016)
Bovidae	*Kobus ellipsiprymnus ellipsiprymnus*		Least Concern (2016)
Bovidae	*Kobus leche*	Lechwe	Near Threatened (2017)
Bovidae	*Oryx gazella*	Gemsbok	Least Concern (2016)
Bovidae	*Ourebia ourebi*	Oribi	Endangered
Bovidae	*Pelea capreolus*	Vaal Rhebok	Near Threatened (2016)
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern (2016)
Bovidae	*Redunca arundinum*	Southern Reedbuck	Least Concern (2016)
Bovidae	*Redunca fulvorufula*	Mountain Reedbuck	Least Concern
Bovidae	*Sylvicapra grimmia*	Bush Duiker	Least Concern (2016)
Bovidae	*Syncerus caffer*	African Buffalo	Least Concern (2008)
Bovidae	*Taurotragus oryx*	Common Eland	Least Concern (2016)
Bovidae	*Tragelaphus angasii*	Nyala	Least Concern (2016)
Bovidae	*Tragelaphus scriptus*	Bushbuck	Least Concern
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern (2016)
Canidae	*Lycaon pictus*	African wild dog	Endangered (2016)
Cervidae	*Dama dama*	Fallow Deer	Introduced
Chrysochloridae	*Chlorotalpa sclateri*	Sclater's Golden Mole	Least Concern (2016)
Equidae	*Equus quagga*	Plains Zebra	Least Concern (2016)
Equidae	*Equus zebra hartmannae*	Hartmann's Mountain Zebra	Vulnerable A3bcd (IUCN, 2019)
Erinaceidae	*Atelerix frontalis*	Southern African Hedgehog	Near Threatened (2016)
Giraffidae	*Giraffa giraffa giraffa*	South African Giraffe	Least Concern (2016)
Herpestidae	*Cynictis penicillata*	Yellow Mongoose	Least Concern (2016)
Herpestidae	*Herpestes sanguineus*	Slender Mongoose	Least Concern (2016)
Leporidae	*Lepus capensis*	Cape Hare	Least Concern
Leporidae	*Lepus saxatilis*	Scrub Hare	Least Concern
Macroscelididae	*Elephantulus myurus*	Eastern Rock Elephant Shrew	Least Concern (2016)
Manidae	*Smutsia temminckii*	Ground Pangolin	Vulnerable (2016)
Muridae	*Aethomys namaquensis*	Namaqua Rock Mouse	Least Concern
Muridae	*Mastomys coucha*	Southern African Mastomys	Least Concern (2016)
Muridae	*Mastomys natalensis*	Natal Mastomys	Least Concern (2016)
Nesomyidae	*Malacothrix typica*	Large-eared African Desert Mouse	Least Concern (2016)
Nesomyidae	*Mystromys albicaudatus*	African White-tailed Rat	Vulnerable (2016)
Pedetidae	*Pedetes capensis*	South African Spring Hare	Least Concern (2016)
Sciuridae	*Xerus inauris*	South African Ground Squirrel	Least Concern
Soricidae	*Crocidura cyanea*	Reddish-gray Musk Shrew	Least Concern (2016)
Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern (2016)
Vespertilionidae	*Neoromicia capensis*	Cape Serotine	Least Concern (2016)

APPENDIX E HERPETOFAUNA LIST

REPTILES

Family	Scientific name	Common name	Red list
Agamidae	*Agama atra*	Southern Rock Agama	Least Concern (SARCA 2014)
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	Least Concern (SARCA 2014)
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	Least Concern (SARCA 2014)
Cordylidae	*Smaug giganteus*	Giant Girdled Lizard	Vulnerable (SARCA 2014)
Elapidae	*Elapsoidea sundevallii media*	Highveld Garter Snake	
Elapidae	*Hemachatus haemachatus*	Rinkhals	Least Concern (SARCA 2014)
Gekkonidae	*Lygodactylus capensis*	Common Dwarf Gecko	Least Concern (SARCA 2014)
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	Least Concern (SARCA 2014)
Lamprophiidae	*Aparallactus capensis*	Black-headed Centipede-eater	Least Concern (SARCA 2014)
Lamprophiidae	*Boaedon capensis*	Brown House Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Homoroselaps lacteus*	Spotted Harlequin Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Lamprophis aurora*	Aurora House Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Lycophidion capense capense*	Cape Wolf Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Prosymna sundevallii*	Sundevall's Shovel-snout	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis crucifer*	Cross-marked Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophis trinasalis*	Fork-marked Sand Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Psammophylax rhombeatus*	Spotted Grass Snake	Least Concern (SARCA 2014)
Lamprophiidae	*Pseudaspis cana*	Mole Snake	Least Concern (SARCA 2014)
Scincidae	*Acontias gracilicauda*	Thin-tailed Legless Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	Least Concern (SARCA 2014)
Scincidae	*Trachylepis varia sensu lato*	Common Variable Skink Complex	Least Concern (SARCA 2014)
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	Least Concern (SARCA 2014)
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	Least Concern (SARCA 2014)

AMPHIBIANS

Family	Scientific name	Common name	Red list
Bufonidae	*Sclerophrys capensis*	Raucous Toad	Least Concern
Bufonidae	*Sclerophrys poweri*	Power's Toad	Least Concern
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	Least Concern
Pipidae	*Xenopus laevis*	Common Platanna	Least Concern
Pyxicephalidae	*Amietia delalandii*	Delalande's River Frog	Least Concern (2017)
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	Least Concern (2013)
Pyxicephalidae	*Pyxicephalus adspersus*	Giant Bull Frog	Near Threatened
Pyxicephalidae	*Tomopterna cryptotis*	Tremelo Sand Frog	Least Concern
Pyxicephalidae	*Tomopterna natalensis*	Natal Sand Frog	Least Concern